METROPOLITAN DISTRICT COMMISSION

FIRST ANNUAL REPORT

1920

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The Commonwealth of Massachusetts

ANNUAL REPORT

OF THE

METROPOLITAN DISTRICT COMMISSION

FOR THE YEAR 1920

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CONTENTS.

Report of the Metropolitan District Commission.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan District Commissioner has already presented to your Honorable Body an abstract of the account of the receipts, expenditures, disbursements and liabilities of the Water and Sewerage Divisions for the fiscal year ending on November 30, 1920, and now presents a detailed statement of the doings of the Commission in the Parks Division for the fiscal year ending November 30, 1920, and in the Water and Sewerage Divisions for the calendar year ending December 31, 1920, being the

FIRST ANNUAL REPORT.

I. ORGANIZATION AND ADMINISTRATION.

Commission, Officers and Employees.

The Metropolitan District Commission was constituted by the appointment of James A. Bailey as Commissioner, Ellerton P. Whitney, Frank A. Bayrd, Frank G. Hall and William H. Squire as Associate Commissioners. By chapter 350 of the General Acts of 1919 all the powers, duties and responsibilities of the Metropolitan Park Commission and the Metropolitan Water and Sewerage Board were transferred to this Commission on December 1, 1919. In accordance with the provisions of section 126 of said chapter the Commissioner organized four divisions, namely, Parks, Park Engineering, Water, Sewerage, and, with the approval of the Governor and Council, appointed as Director of Parks, Ellerton P. Whitney; Director of Park Engineering, John R. Rablin; Director of the Water Division, William E. Foss; Director of the Sewerage Division, Frederick D. Smith.

All directors of divisions served without extra compensation, receiving only the salaries attached to the other positions which they held.

The Commissioners appointed George Lyman Rogers secretary, William N. Davenport executive secretary, Alfred F. Bridgman purchasing agent; and the following chief engineers: of parks, John R. Rablin; water, William E. Foss; sewerage, Frederick D. Smith.

Mary V. Habberley has continued as bookkeeper and financial secretary of the Parks Division, and Alice G. Mason as bookkeeper of the Water and Sewerage Divisions. Upon the resignation of William N. Davenport, after twenty-five years of faithful and efficient service as secretary and executive secretary, May L. Powers was appointed financial secretary of the Water and Sewerage Divisions.

Herbert W. West has continued as superintendent of the Revere Beach Division and Charles River Division, Lower Basin; Elmer E. Bickford as superintendent of Nantasket Beach Division; Bartholomew J. Costello as superintendent of Blue Hills Division; John L. Gilman as superintendent of Charles River Upper Division; Albert N. Habberley as superintendent of Middlesex Fells Division.

The organization of the Water and Sewerage Divisions is stated in detail in the accompanying reports of the directors of those divisions.

The maximum number of employees during the year was 1,511, divided as follows: general offices, 32; parks, 924; water, 374; sewerage, 181.

In this tabulation of employees the police are included under Parks, although considerable protection of the water system is given by the metropolitan district police.

Offices.

The principal office of the Commission is the suite of rooms on the third floor of the Kimball Building, 18 Tremont Street, occupied for many years by the Metropolitan Park Commission. The buildings numbered 1 and 3 Ashburton Place, formerly used by the Metropolitan Water and Sewerage Board, still contain the main water and sewerage engineering offices, and the bookkeeping and clerical offices and laboratories of the Water and Sewerage Divisions. Al-

though the distance between these buildings is short, the present division of offices between two buildings is unsatisfactory, and constant but unsuccessful efforts have been made to obtain one home for all departments. As there is no available space in the State House, and adequate quarters elsewhere cannot be obtained, it seems wise to construct a suitable building in which the administrative, engineering and clerical offices may be concentrated, and the valuable plans and other property in charge of the Commission reasonably safeguarded.

It seems probable that the activities of this Commission may be increased considerably in the years to come, and a well-located and properly constructed building is the natural and necessary center of the varied and important interests of the metropolitan district.

II. GENERAL FINANCIAL STATEMENT.

An analysis and summary of the detailed financial statements contained in this report show the following costs, exclusive of annual maintenance expenditures, and debt conditions: —

November 30, 1919.

Cost of metropolitan park, water and sewerage systems,	$81,328,485 66
Gross debt,	77,121,874 50
Sinking funds,	26,597,482 80
Net debt,	50,524,391 70

During the Year ending November 30, 1920.

Increase in cost,	$544,709 19
Increase in gross debt,	206,943 75
Increase in sinking funds,	1,897,632 41
Decrease in net debt,	1,690,688 66

On November 30, 1920.

Net debt,	$48,833,703 04

The per capita net metropolitan debt based on the average population of the parks, water and sewerage districts is $36.79. Adding to this figure the proportional part of the net direct State debt borne by the inhabitants of the metropolitan district, which is $9.12, it appears that the per capita State and metropolitan net debt is $45.91.

A compilation of the net bonded debts of all States published in 1919 by Alfred D. Chandler, Esq., indicated that the per capita State and metropolitan net debt upon the inhabitants of the metropolitan district of Massachusetts was more than double that of any other State in the Union. In this study the debts of municipalities, in the aggregate a great sum, are not included.

III. GENERAL POLICY OF COMMISSION.

The Commission, in formulating its policy and carrying on its work, has kept in mind the heavy burden of debt and taxation — national, State, metropolitan, and municipal — resting upon the inhabitants of this district. It has not overlooked the further fact that the metropolitan water works as designed in 1895 still require a considerable expenditure for completion, and if population and consumption of water continue to increase, more than $50,000,000 may be required in the next ten years for additional sources of water supply.

On December 13, 1919, in a letter to Governor Coolidge, the Commission said: —

> The men who secured for the public the great reservations of forest, shore and river did not contemplate the early expenditure of such large sums as the boulevards and other improvements have already cost. The heavy annual maintenance charge of the metropolitan park system must be met, but no appropriation for construction ought to be made until imperatively required.

Recognizing that its duties are administrative, and that efficiency in the conduct of its work is essential to the public welfare, the Commission has effected numerous economies during the year. The consolidation of boards made it possible to have one secretary and one purchasing agent instead of two formerly required in each position. A reduction in the clerical force was made. The services of eight men at the Charles River Dam were found to be unnecessary, and their names were stricken from the pay roll. The police force, which is required in full numbers during the summer months, has been reduced by resignations, discharges and otherwise during the fall and winter months by a total of twenty-one men.

Several hundred naphtha lamps on outlying, uninhabited sections of parkways were extinguished during the year. These lamps were expensive, unsatisfactory and of little use, and an annual saving of about $14,000 was effected by their discontinuance.

Various buildings, privileges and concessions were let in publicly advertised competition, wherever feasible, and rentals were obtained many thousands of dollars in excess of former returns.

During the year wages and salaries in all branches of State service were considerably increased, and the prices of coal and other materials used in the various works were unreasonably and unexpectedly high for many months. An effort was made to conserve appropriations, and defer construction which was not imperatively required. Of the total appropriations for maintenance the unexpended balances amounted to $153,264.22.

A substantial saving to every city and town in the parks district was effected by the passage of chapter 443 of the Acts of 1920, entitled, "An Act to establish a basis for determining the annual assessments upon the municipalities within the Metropolitan Parks District for interest, sinking fund and serial bond requirements and cost of maintenance." This act, drawn by the secretary and introduced by the Commission, extended to the parks district the wise principle of legislative determination of assessments on municipalities, which principle was incorporated in the water act in 1895, and extended to the sewerage districts in 1906.

By the passage of this act the costly machinery of metropolitan apportionment commissions — with their long-drawn-out hearings, salaried commissioners, formidable array of counsel, stenographers, printing bills and incidental expenses — became a memory.

IV. FINANCIAL STATEMENT.

The financial abstract of the receipts, disbursements, assets and liabilities of the Metropolitan District Commission, Water and Sewerage Divisions, for the State fiscal year, beginning with December 1, 1919, and ending with November 30, 1920, was, in accordance with the requirements of chapter 235 of the Acts of the year 1906, presented to the General Court in January last, and a copy of this financial abstract is printed as Appendix No. 5.

As required by said chapter a detailed statement of its doings for the calendar year 1920, in relation to the Metropolitan Water and Sewerage Works, is herewith presented.

WATER WORKS.

Construction.

(1) Water Loans — Receipts and Payments.

Total loans authorized to January 1, 1921,		$45,685,000 00
Receipts from the sales of property applicable to the construction and acquisition of works: —		
For the period prior to January 1, 1920,	$259,342 67	
For the year ending December 31, 1920,	5,560 96	
		264,903 63
Receipt from the town of Swampscott for admission to district (St. 1909, c. 320),		90,000 00
Total amount authorized to January 1, 1921,		$46,039,903 63
Amounts approved by Board for payments out of Water Loan Fund: —		
Payments prior to January 1, 1920,	$43,257,951 63	
Approved for year ending December 31, 1920,	29,924 26	
		43,287,875 89
Amount authorized but not expended January 1, 1921,		$2,752,027 74

(2) Total Water Debt, December 31, 1920.

Water Loan Outstanding, Sinking Fund and Debt.

Bonds issued by the Treasurer of the Commonwealth: —		
Sinking fund bonds (3 and 3½ per cent),		$41,398,000 00
Serial bonds (3½, 4 and 4¼ per cent),		1,549,000 00
Total bond issue to December 31, 1920,		$42,947,000 00
Serial bonds paid prior to January 1, 1920,	$178,000 00	
Serial bonds paid in 1920,	43,000 00	
		221,000 00
Total bond issue outstanding December 31, 1920,		$42,726,000 00
Gross water debt,		$42,726,000 00
Sinking fund December 31, 1920,		16,953,165 15
Net water debt December 31, 1920,		$25,772,834 85

A decrease for the year of $1,057,620.01.

(3) Metropolitan Water Loan and Sinking Fund, December 31, 1920.

Year.	Authorized Loans.	Bonds issued (Sinking Fund).	Bonds issued (Serial Bonds).	Sinking Fund.
1895,	$27,000,000	$5,000,000	–	$226,286 05
1896,	–	2,000,000	–	699,860 70
1897,	–	6,000,000	–	954,469 00
1898,	–	4,000,000	–	1,416,374 29
1899,	–	3,000,000	–	1,349,332 97
1900,	–	1,000,000	–	1,573,619 72
1901,	13,000,000	10,000,000	–	1,662,426 95
1902,	–	3,500,000	–	2,256,803 81
1903,	–	1,500,000	–	2,877,835 59
1904,	–	2,500,000	–	3,519,602 92
1905,	–	650,000	–	4,207,045 69
1906,	500,000	1,350,000	–	4,897,822 62
1907,	–	–	–	5,643,575 69
1908,	398,000	–	–	6,419,283 28
1909,	900,000	398,000	–	7,226,262 31
1910,	80,000	500,000	–	8,089,902 91
1911,	212,000	–	$200,000	8,953,437 44
1912,	600,000	–	190,000	9,829,356 80
1913,	108,000	–	–	10,767,701 68
1914,	–	–	258,000	11,533,453 45
1915,	–	–	490,000	12,491,245 25
1916,	–	–	66,000	13,268,199 36
1917,	–	–	150,000	14,036,278 88
1918,	115,000	–	–	14,870,834 84
1919,	67,000	–	161,000	15,904,545 14
1920,	2,705,000	–	34,000	16,953,165 15
	$45,685,000	$41,398,000	$1,549,000	–

(4) Water Assessment, 1920.

The following water assessment was made by the Treasurer of the Commonwealth upon the various municipalities: —

Sinking fund requirements,	$248,053 52
Serial bonds,	44,000 00
Interest,	1,479,376 58

Maintenance: —		
Appropriated by Legislature,	$815,683 52	
Less balance on hand,	68,830 10	
		$746,853 42
Total water assessment for 1920,		$2,518,283 52

In accordance with chapter 488, Acts of 1895, as amended in 1901, 1904 and 1906, the proportion to be paid by each city and town is based one-third in proportion to their respective valuations and the remaining two-thirds in proportion to their respective water consumption for the preceding year, except that but one-fifth of the total valuation and no consumption has been taken for the city of Newton, as it has not been supplied with water from the metropolitan works.

The division of the assessment for 1920 was as follows: —

Cities and Towns.	Assessment.	Cities and Towns.	Assessment.
Arlington,	$23,603 88	Nahant,	$4,323 90
Belmont,	13,440 08	Newton,	6,557 62
Boston,	1,885,924 91	Quincy,	85,259 00
Chelsea,	59,247 66	Revere,	35,210 63
Everett,	57,061 77	Somerville,	127,505 74
Lexington,	9,156 47	Stoneham,	11,488 42
Malden,	54,639 20	Swampscott,	13,764 93
Medford,	38,174 66	Watertown,	38,534 77
Melrose,	23,153 10	Winthrop,	17,975 50
Milton,	13,261 28		$2,518,283 52

(5) Supplying Water to Cities and Towns outside of District and to Water Companies.

Sums have been received during the year 1920 under the provisions of the metropolitan water act, for water furnished, as follows: —

Town of Framingham,	$4,447 78
City of Revere (on account of water furnished to a portion of the town of Saugus for 1919),	580 00
United States government (for Peddock's Island),	1,081 39
Westborough State Hospital,	2,180 10
	$8,289 27

The sums so received prior to March 23, 1907, were annually distributed among the cities and towns of the district, but since that date, in accordance with the provisions of chapter 238 of the Acts of 1907, the sums so received have been paid into the sinking fund.

(6) Expenditures for the Different Works.

The following is a summary of the expenditures made in the various operations for the different works: —

Construction and Acquisition of Works.	For the Year ending December 31, 1920.	
Administration applicable to all parts of the construction and acquisition of the works,		$2,730 00
Distribution system: —		
Low service: —		
Section 46 (additional water supply for the East Boston district of the city of Boston),	$4,438 87	
Northern high service: —		
Section 48 (reinforcement of the northern high-service pipe lines),	987 87	
Section 49 (reinforcement of the northern high-service pipe lines),	864 77	
Section 50 (reinforcement of the northern high-service pipe lines),	1,000 08	
Additional pumping machinery at Spot Pond pumping station,	550 73	
Southern high service: —		
Additional pumping machinery at Chestnut Hill pumping station of the southern high service,	1,524 92	
Northern extra high service: —		
Arlington Reservoir in Arlington, Mass.,	1,217 24	
Section 45 (additional water supply for the town of Lexington),	8,903 09	
Southern extra high service: —		
Section 44 (additional water supply for the town of Milton and the Hyde Park district of the city of Boston),	2,192 12	
Meters and connections,	994 66	
		22,674 35
Stock — pipes, valves, castings, etc., purchased and sent first to storage yards, and later transferred, as needed, to the various parts of the work: —		
Amount received,	$5,913 00	
Transferred from storage yards to the various sections of the work and included in costs of special works,	1,393 09	
		4,519 91
		$29,924 26
Amount charged from beginning of work to January 1, 1920,		43,257,951 63
Total for construction and acquisition of works to January 1, 1921,		$43,287,875 89

Maintenance and Operation.		For the Year ending December 31, 1920.
Administration,		$13,191 22
General supervision,		42,397 40
Taxes and other expenses,		47,289 03
Wachusett Department: —		
Superintendence,	$11,162 99	
Reservoir,	22,375 81	
Forestry,	14,138 99	
Protection of supply,	7,078 04	
Buildings and grounds,	4,361 70	
Wachusett Dam,	10,922 38	
Wachusett Aqueduct,	11,377 43	
Clinton sewerage system: —		
Pumping station,	2,560 26	
Sewers, screens and filter beds,	9,017 69	
Sanitary inspection,	660 20	
Swamp drainage,	7,237 71	
Power plant,	22,678 86	
Wachusett-Sudbury power transmission line,	77 08	
Payments under industrial accident law and special benefit appropriations,	462 51	
		124,111 65
Sudbury Department: —		
Superintendence, Framingham office,	$14,992 47	
Ashland Reservoir,	3,787 89	
Hopkinton Reservoir,	3,575 65	
Whitehall Reservoir,	3,508 88	
Framingham Reservoirs Nos. 1, 2 and 3,	13,902 28	
Sudbury Reservoir,	13,324 60	
Lake Cochituate,	11,266 66	
Marlborough Brook filters,	7,002 73	
Pegan filters,	7,846 08	
Sudbury and Cochituate watersheds,	2,570 27	
Sanitary inspection,	3,844 90	
Cochituate Aqueduct,	4,713 36	
Sudbury Aqueduct,	9,394 18	
Weston Aqueduct,	9,023 37	
Forestry,	10,006 09	
Power plant,	11,496 19	
Payments under industrial accident law and special benefit appropriations,	38 00	
		130,293 60
Distribution Department: —		
Superintendence,	$10,576 18	
Pumping service: —		
Superintendence,	8,298 80	
Payments under industrial accident law and special benefit appropriations,	984 38	
Arlington pumping station, pumping service,	18,227 90	
Chestnut Hill low-service pumping station, pumping service,	146,674 97	
Chestnut Hill high-service pumping station, pumping service,	52,123 84	
Spot Pond pumping station, pumping service,	44,516 11	
Hyde Park pumping station, pumping service,	12,184 20	
Amounts carried forward,	$293,586 38	$338,598 82

Maintenance and Operation.	For the Year ending December 31, 1920.	
Amounts brought forward,	$293,586 38	$338,598 82
Distribution Department — *Con.*		
Bear Hill Reservoir,	294 65	
Chestnut Hill Reservoir and grounds,	17,945 42	
Fells Reservoir,	1,759 44	
Forbes Hill Reservoir,	3,011 23	
Mystic Lake, conduit and pumping station,	6,151 97	
Mystic Reservoir,	946 81	
Waban Hill Reservoir,	507 16	
Weston Reservoir,	5,701 32	
Spot Pond,	10,498 86	
Buildings at Spot Pond,	1,430 33	
Pipe lines: —		
Low service,	49,332 82	
Northern high service,	14,098 78	
Northern extra high service,	230 22	
Southern high service,	14,102 34	
Southern extra high service,	357 97	
Supply pipe lines,	1,793 99	
Buildings at Chestnut Hill Reservoir,	4,952 40	
Chestnut Hill pipe yard,	2,683 45	
Glenwood pipe yard and buildings,	3,450 67	
Stables,	10,434 39	
Venturi meters,	2,077 80	
Measurement of water,	4,711 82	
Arlington pumping station, buildings and grounds,	573 54	
Hyde Park pumping station, buildings and grounds,	430 71	
Fisher Hill Reservoir,	3,160 99	
Bellevue Reservoir,	264 37	
Payments under industrial accident law and special benefit appropriations,	625 29	
Improvement and protection of water supplies,	1 77	
		455,116 89
Total for maintaining and operating works,		$812,399 79

(7) Detailed Financial Statement under Metropolitan Water Act.

The Commissioner herewith presents, in accordance with the requirements of the metropolitan water act, a detailed statement of the expenditures and disbursements, receipts, assets and liabilities for the year 1920.

(*a*) *Expenditures and Disbursements.*

The total amount of the expenditures and disbursements on account of construction and acquisition of works for the year beginning January 1, 1920, and ending December 31, 1920, was $29,924.26

and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1920, has been $43,287,875.89.

For maintenance and operation the expenditures for the year were $812,399.79.

The salaries of the commissioners, and the other expenses of administration, have been apportioned to the construction of the works and to the maintenance and operation of the same, and appear under each of those headings.

The following is a division of the expenditures according to their general character: —

General Character of Expenditures.	For the Year ending December 31, 1920.	
Construction of Works and Acquisition by Purchase or Taking.		
Administration.		
Commissioners,	$450 03	
Secretary,	523 00	
Clerks and stenographers,	1,180 00	
Stationery and printing,	190 10	
Postage, express and telegrams,	36 00	
Telephone, lighting, heating, water and care of building,	201 65	
Rent and taxes, main office,	144 22	
Miscellaneous expenses,	5 00	
		$2,730 00
Engineering.		
Principal assistant engineers,	$1,096 42	
Engineering assistants,	4,030 63	
Inspectors,	315 00	
Railroad and street car travel,	10	
Stationery and printing,	31 86	
Telephone, lighting, heating, water and care of buildings, main office,	605 03	
Rent and taxes, main office,	432 68	
Miscellaneous expenses,	2 90	
		6,514 62
Construction.		
Preliminary work: —		
Advertising,		80 75
Contracts, distribution system: —		
John A. Gaffey, for resurfacing about 1,000 feet of Massachusetts Avenue in Arlington, Mass., along Section 45 of the northern extra high-service pipe lines (additional water supply for the town of Lexington, Mass.), Contract 2 (new series),	$3,031 80	
Warren Foundry & Machine Co., for furnishing cast-iron water pipes and special castings for use on Section 44 of the southern extra high service (additional water supply for the town of Milton, Mass., and the Hyde Park district of the city of Boston), Contract 393 (in part),	646 91	
Amounts carried forward,	$3,678 71	$9,325 37

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$3,678 71	$9,325 37
Construction — Con.		
Contracts, distribution system — *Con.*		
Warren Foundry & Machine Co., for furnishing cast-iron water pipes and special castings for use on Section 45 of the northern extra high service (additional water supply for the town of Lexington, Mass.), Contract 393 (in part),	2,330 04	
Warren Foundry & Machine Co., for furnishing cast-iron water pipes and special castings for use on Section 46 of the low service (additional water supply for the East Boston district of the city of Boston), Contract 393 (in part),	2,486 82	
Warren Foundry & Machine Co., for furnishing cast-iron water pipes and special castings, Contract 393 (in part),	2,927 28	
Vincenzo Grande, for laying water pipes in West Roxbury, Mass., Section 44 of the southern extra high service (additional water supply for the town of Milton and the Hyde Park district of the city of Boston), Contract 394,	487 34	
James Barletta for laying water pipes in Arlington, Mass., Section 45 of the northern extra high service (additional water supply for the town of Lexington, Mass.), Contract 395,	1,816 60	
Coleman Bros., for laying water pipes in Chelsea, Mass., Section 46 of the low service (additional water supply for the East Boston district of the city of Boston), Contract 396,	1,313 26	
		15,040 05
Additional work: —		
Labor,	$2,160 92	
Freight and express,	239 03	
Castings, ironwork and metals,	589 33	
Iron pipe and valves,	1,686 82	
Brick, cement and stone,	89 55	
Sand, gravel and filling,	16 25	
Tools, machinery, appliances and hardware supplies,	685 00	
Municipal and corporation work,	78 84	
Miscellaneous expenses,	9 30	
		5,555 04
Real Estate.		
Legal and expert: —		
Conveyancing expenses,		3 80
		$29,924 26
Amount charged from beginning of work to January 1, 1920,		43,257,951 63
Total amount of construction expenditures to January 1, 1921,		$43,287,875 89
Maintenance and Operation of Works.		
Administration: —		
Commissioners,	$2,150 00	
Secretary and assistants,	7,771 68	
Rent,	689 05	
Amount carried forward,	$10,610 73	

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$10,610 73	
Administration — *Con.*		
Repairs of building,	32 42	
Fuel,	129 02	
Lighting,	67 74	
Care of building,	719 46	
Postage,	170 00	
Printing, stationery and office supplies,	1,098 95	
Telephones,	135 66	
Traveling expenses,	37 10	
Miscellaneous expenses,	190 14	
		$13,191 22
General supervision: —		
Chief engineer and assistants,	$32,794 71	
Rent,	2,067 23	
Repairs of building,	100 25	
Fuel,	387 05	
Lighting,	203 24	
Care of building,	2,158 83	
Postage,	165 00	
Express and telegrams,	164 07	
Printing, stationery and office supplies,	1,896 67	
Telephones,	488 71	
Traveling expenses,	1,242 61	
Miscellaneous expenses,	729 03	
		42,397 40
Pumping service: —		
Superintendence,	$8,298 80	
Labor,	120,685 56	
Fuel,	120,740 63	
Oil, waste and packing,	3,591 53	
Repairs,	26,448 74	
Small supplies,	2,260 56	
Payments under industrial accident law and special benefit appropriations,	984 38	
		283,010 20
Reservoirs, aqueducts, pipe lines, buildings and grounds: —		
Superintendents,	$8,678 17	
Engineering assistants,	19,588 68	
Sanitary inspectors,	3,853 60	
Labor, pay roll,	283,558 10	
Labor, miscellaneous,	10,291 63	
Alterations and repairs of pumping stations,	1,714 02	
Alterations and repairs of other buildings and structures,	10,156 07	
Automobiles,	18,277 74	
Brick,	534 63	
Brooms, brushes and janitor's supplies,	545 57	
Castings, ironwork and metals,	1,449 02	
Cement and lime,	1,192 25	
Drafting and photo supplies,	418 89	
Amounts carried forward,	$360,258 37	$338,598 82

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$360,258 37	$338,398 82
Reservoirs, aqueducts, pipe lines, buildings and grounds — *Con.*		
Electrical supplies,	1,713 35	
Fertilizer and planting material,	1,721 24	
Freight and express,	491 89	
Fuel,	6,199 78	
Gypsy moth supplies,	2,742 98	
Hardware,	2,907 70	
Hay and grain,	1,347 57	
Horses,	1,415 00	
Lighting,	373 10	
Lumber,	3,870 56	
Machinery,	2,044 63	
Paints and oils,	2,855 95	
Pipe and fittings,	4,032 89	
Postage,	159 79	
Printing, stationery and office supplies,	3,020 66	
Rubber and oiled goods,	708 26	
Stable expenses,	1,082 79	
Sand, gravel and stone,	777 34	
Traveling expenses,	2,992 19	
Telephones,	1,483 69	
Teaming,	5,803 37	
Tools and appliances,	7,397 36	
Vehicles, harnesses and fittings,	1,028 76	
Miscellaneous expenses,	5,337 42	
Contracts: —		
Thomas A. Elston & Co., Inc., Contract 3-M (new series), for razing the brick chimney at the old Mystic pumping station in West Somerville, Mass.,	1,335 31	
Improvement and protection of water supplies,	1,597 79	
Water from city of Worcester,	686 40	
Payments under industrial accident law and special benefit appropriations,	1,125 80	
		426,511 94
Payments in lieu of taxes,		47,289 03
Total expenditures for maintenance and operation,		$812,399 79

(*b*) *Receipts.*

The total amount of receipts from the operations of the Commission and from sales of property for the year beginning January 1, 1920, and ending December 31, 1920, was $119,357.44, and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1920, has been $1,718,373.08. The general character of these receipts is as follows: —

General Character of Receipts.		For the Year ending December 31, 1920.
Applicable to the loan fund: —		
Construction tools, supplies and reimbursements,		$5,560 96
Applicable to payment of interest, sinking fund requirements and expenses of maintenance and operation: —		
Proceeds from operations of the Board: —		
Rents,	$4,990 14	
Land products,	6,944 79	
Electric energy,	89,734 09	
Maintenance labor, tools, supplies and reimbursements,	3,722 11	
Interest and unclassified receipts,	116 08	
		105,507 21
Applicable to the sinking fund: —		
Water supplied to cities and towns, water companies and others,		8,289 27
		$119,357 44
Amount credited from beginning of work to January 1, 1920,		1,599,015 64
Total receipts to January 1, 1921,		$1,718,373 08

The foregoing receipts have been credited to the various objects or works, as follows: —

Sources of Receipts.		For the Year ending December 31, 1920.
Supplying water outside of water district,		$8,289 27
Construction and acquisition of works: —		
Administration,	$117 92	
Wachusett Reservoir,	287 50	
Distribution system,	5,271 06	
		5,676 48
Maintenance and operation of works: —		
Administration,	$266 95	
General supervision,	669 65	
Wachusett Aqueduct,	254 15	
Wachusett Reservoir,	5,865 35	
Wachusett electric power plant,	50,115 42	
Sudbury system,	3,186 17	
Sudbury electric power plant,	39,653 32	
Distribution system,	3,669 20	
Clinton sewerage system,	1,711 48	
		105,391 69
		$119,357 44
Amount credited from beginning of work to January 1, 1920,		1,599,015 64
Total receipts to January 1, 1921,		$1,718,373 08

(c) *Assets.*

The following is an abstract of the assets of the water works, a complete schedule of which is kept on file in the office of the Commission: —

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; police supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate and buildings connected therewith.

(d) *Liabilities.*

There are sundry bills for current expenses which have not yet been received.

Amount on Monthly Estimates, not due until Completion of Contract or until Claims are settled.

Name.	Work.	Amount.
Joseph Hanreddy, ...	Contract 314, Section 7 of the Weston Aqueduct supply mains, in Newton, Mass.	$10 00

Settlements are pending with the following parties for land and easements taken in lands owned by them: —

New York, New Haven & Hartford Railroad Company, Frederique Ropp, heirs of Ella Wood, Jack Calcia, Brayton D. Fisher, heirs of Andrew Temple.

SEWERAGE WORKS.

(1) Metropolitan Sewerage Loans, Receipts and Payments.

The loans authorized for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of these loans, the expenditures for construction, and the balances available on January 1, 1921, have been as follows: —

North Metropolitan System.

Loans authorized under various acts to January 1, 1921, for the construction of the North Metropolitan System and the various extensions, ... $7,512,365 73

Receipts from sales of real estate and from miscellaneous sources which are placed to the credit of the North Metropolitan System: —			
For the year ending December 31, 1920,	$1,114 99		
For the period prior to January 1, 1920,	86,233 22		
		$87,348 21	
			$7,599,713 94
Amount approved for payment from the Metropolitan Sewerage Loan Fund, North System: —			
For the year ending December 31, 1920,	$105,099 11		
For the period prior to January 1, 1920,	7,441,558 47		
		7,546,657 58	
Balance, North Metropolitan System, January 1, 1921,			$53,056 36

South Metropolitan System.

Loans authorized under the various acts to January 1, 1921, applied to the construction of the Charles River valley sewer, Neponset valley sewer, high-level sewer and extensions, constituting the South Metropolitan System,			$9,912,046 27
Receipts from pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System: —			
For the year ending December 31, 1920,	$141 40		
For the period prior to January 1, 1920,	19,739 65		
		19,881 05	
			$9,931,927 32
Amount approved for payment from the Metropolitan Sewerage Loan Fund, South System: —			
On account of the Charles River valley sewer,	$800,046 27		
On account of the Neponset valley sewer,	911,531 46		
On account of the high-level sewer and extensions, including Wellesley extension: —			
For the year ending December 31, 1920,	$214,185 90		
For the period prior to January 1, 1920,	7,880,678 82		
		8,094,864 72	
			9,806,442 45
Balance, South Metropolitan System, January 1, 1921,			$125,484 87

(2) Total Sewerage Debt, December 31, 1920.

North Metropolitan System.

Bonds issued by the Treasurer of the Commonwealth: —		
Sinking fund bonds (3 and 3½ per cent),		$6,563,000 00
Serial bonds (3½ and 4 per cent),		925,500 00
Total bond issue to December 31, 1920,		$7,488,500 00
Serial bonds paid prior to January 1, 1920,	$128,000 00	
Serial bonds paid in 1920,	26,500 00	
		154,500 00
Total bond issue outstanding December 31, 1920,		$7,334,000 00
Gross sewerage debt,		$7,334,000 00
Sinking fund December 31, 1920,		3,221,141 35
Net sewerage debt December 31, 1920,		$4,112,858 65

A net decrease for the year of $301,426.27.

South Metropolitan System.

Bonds issued by the Treasurer of the Commonwealth: —		
Sinking fund bonds (3 and 3½ per cent),		$8,877,912 00
Serial bonds (4, 4½ and 5 per cent),		945,000 00
Total bond issue to December 31, 1920,		$9,822,912 00
Serial bonds paid prior to January 1, 1920,	$63,000 00	
Serial bonds paid in 1920,	27,000 00	
		90,000 00
Total bond issue outstanding December 31, 1920,		$9,732,912 00
Gross sewerage debt,		$9,732,912 00
Sinking fund December 31, 1920,		1,947,382 68
Net sewerage debt December 31, 1920,		$7,785,529 32

A net decrease for the year of $24.69.

(3) North and South Metropolitan Loan and Sinking Funds, December 31, 1920.

Year.	Loans.		Bonds issued (Sinking Fund).		Bonds issued (Serial Bonds).		Sinking Fund.
	North System.	South System.	North System.	South System.	North System.	South System.	North and South Systems.
1889,	$5,000,000 00	–	–	–	–	–	–
1890,	–	–	$2,200,000	$800,000	–	–	–
1891,	–	–	368,000	–	–	–	–
1892,	–	–	1,053,000	–	–	–	–
1893,	–	–	579,000	–	–	–	–
1894,	500,000 00	–	500,000	–	–	–	–
1895,	300,000 00	$500,000 00	300,000	300,000	–	–	–
1896,	30,000 00	–	30,000	200,000	–	–	–
1897,	85,000 00	300,000 00	80,000	300,000	–	–	–
1898,	215,000 00	35,000 00	220,000	35,000	–	–	–
1899,	–	4,625,000 00	–	1,025,000	–	–	$361,416 59
1900,	265,000 00	10,912 00[1]	265,000	10,912	–	–	454,520 57
1901,	–	40,000 00	–	2,040,000	–	–	545,668 26
1902,	–	–	–	864,000	–	–	636,084 04
1903,	500,000 00	1,000,000 00	500,000	1,736,000	–	–	754,690 41
1904,	–	392,000 00	–	392,000	–	–	878,557 12
1905,	–	–	–	–	–	–	1,008,724 95
1906,	55,000 00	1,175,000 00	55,000	175,000	–	–	1,146,998 68
1907,	–	–	–	300,000	–	–	1,306,850 30
1908,	413,000 00	–	–	700,000	–	–	1,492,418 98
1909,	–	–	300,000	–	–	–	1,673,784 40
1910,	56,000 00	–	113,000	–	–	–	1,931,741 89
1911,	6,000 00	–	–	–	–	–	2,184,674 98
1912,	378,000 00	–	–	–	$62,000	–	2,458,541 20
1913,	–	–	–	–	378,000	–	2,749,337 90
1914,	130,500 00	350,000 00	–	–	–	–	3,011,512 44
1915,	83,000 00[2]	5,000 00	–	–	130,500	–	3,290,979 46
1916,	285,000 00	40,000 00	–	–	70,000	$355,000	3,604,657 27
1917,	–	325,000 00	–	–	285,000	40,000	3,925,792 75
1918,	–	–	–	–	–	325,000	4,270,205 50
1919,	–	225,000 00	–	–	–	–	4,695,573 07
1920,	–	100,000 00	–	–	–	225,000	5,168,524 03
	$8,301,500 00[3]	$9,122,912 00	–	–	–	–	–
	789,134 27	789,134 27	–	–	–	–	–
	$7,512,365 73	$9,912,046 27	$6,563,000	$8,877,912	$925,500	$945,000	–

[1] The sum of $10,912 was appropriated to reimburse the town of Watertown for the expense of constructing the Watertown siphon.

[2] This amount includes $13,000, balance of appropriation for north metropolitan maintenance under chapter 775, Acts of 1914, which was transferred to North Metropolitan Loan Fund, under authority of chapter 76, Resolves of 1915. No bonds to be issued, as this was cash.

[3] Of this amount, $789,134.27 was expended for the construction of the Charles River valley sewer, which is now included in the South Metropolitan System.

(4) Sewer Assessments, 1920.

The following sewer assessments were made by the Treasurer of the Commonwealth upon the various municipalities: —

North Metropolitan Sewerage System.

Sinking fund requirements,	$140,135 69
Serial bonds,	24,000 00
Interest,	234,826 02

Maintenance: —		
Appropriated by Legislature,	$292,576 56	
Less balance on hand,	44,219 37	
		$248,357 19
Total North Metropolitan sewerage assessment,		$647,318 90

South Metropolitan Sewerage System.

Sinking fund requirements,		$115,396 83
Serial bonds,		27,000 00
Interest,		337,623 81
Maintenance: —		
Appropriated by Legislature,	$182,603 02	
Less balance on hand,	15,341 94	
		167,261 08
Total South Metropolitan sewerage assessment,		$647,281 72

In accordance with the provisions of chapter 369, Acts of 1906, the proportion to be paid by each city and town to meet the interest and sinking fund requirements for each year is based upon their respective taxable valuations, and to meet the cost of maintenance and operation upon their respective populations.

The divisions of the assessments for 1920 were as follows: —

North Metropolitan Sewerage System.

Cities and Towns.	Assessment.	Cities and Towns.	Assessment.
Arlington,	$18,945 58	Reading,[1]	$5,266 29
Belmont,	11,661 00	Revere,	25,805 29
Boston,	100,545 47	Somerville,	89,939 26
Cambridge,	136,545 79	Stoneham,	7,263 45
Chelsea,	42,296 59	Wakefield,	13,847 34
Everett,	41,563 16	Winchester,	15,193 51
Lexington,	5,254 64	Winthrop,	15,538 04
Malden,	47,039 98	Woburn,	17,157 65
Medford,	34,344 10		
Melrose,	19,111 76	Total,	$647,318 90

[1] Reading is also assessed $7,000 for sinking fund requirements in accordance with section 5, chapter 159, General Acts of 1916.

South Metropolitan Sewerage System.

Cities and Towns.	Assessment.	Cities and Towns.	Assessment.
Boston,	$320,757 57	Waltham,	$36,630 74
Brookline,	85,939 62	Watertown,	27,861 53
Dedham,	14,579 76	Wellesley,[1]	11,808 50
Milton,	18,537 12		
Newton,	76,861 69	Total,	$647,281 72
Quincy,	54,305 19		

[1] Wellesley is also assessed $6,775.23 for sinking fund requirements in accordance with section 5, chapter 343, Acts of 1914.

(5) Expenditures for the Different Works.

The following is a summary of the expenditures made in the various operations for the different works: —

Construction and Acquisition of Works.			For the Year ending December 31, 1920.	
North Metropolitan System.				
North System, enlargement: —				
Administration,			$2,969 86	
Reading extension: —				
Section 73,		$2,783 97		
Section 74,		13,497 61		
Section 75,		21,544 37		
Section 76,		62,510 37		
Real estate settlements,		1,656 00		
Legal, conveyancing and expert,		136 93		
			102,129 25	
				$105,099 11
Amount charged from beginning of work to January 1, 1920,				7,441,558 47
Total for North Metropolitan System to January 1, 1921,				$7,546,657 58
South Metropolitan System.				
High-level sewer extensions: —				
Administration,			$3,078 79	
Wellesley extension: —				
Section 98,		$720 39		
Section 99,		76,398 42		
Section 100,		92,852 84		
Section 101,		39,007 83		
Section 102,		1,384 99		
Section 103,		173 00		
Section 105,		14 00		
Section 106,		64 38		
Real estate settlements,		453 00		
Legal, conveyancing and expert,		38 26		
			211,107 11	
				$214,185 90
Amount charged from beginning of work to January 1, 1920,				9,592,256 55
Total for South Metropolitan System to January 1, 1921,				$9,806,442 45
Total for construction, both systems,				$17,353,100 03

Maintenance and Operation.	For the Year ending December 31, 1920.
North Metropolitan System,	$309,476 17
South Metropolitan System,	190,826 44
Total for maintenance, both systems,	$500,302 61

(6) Detailed Financial Statement.

The Commissioner herewith presents, in accordance with the metropolitan sewerage acts, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the year ending December 31, 1920: —

(*a*) *Expenditures and Disbursements.*

General Character of Expenditures.	For the Year ending December 31, 1920.	
Construction of Works and Acquisition by Purchase or Taking. *North System Enlargement.*		
Administration: —		
Commissioners,	$499 99	
Secretary,	230 00	
Clerks and stenographers,	1,703 17	
Stationery, printing and office supplies,	170 94	
Telephone, lighting, heating, water and care of building,	196 71	
Rent and taxes, main office,	160 25	
Miscellaneous expenses,	8 80	
		$2,969 86
Engineering: —		
Chief engineer,	$416 67	
Engineering assistants,	5,184 11	
Inspectors,	571 15	
Traveling expenses,	236 98	
Stationery, printing and office supplies,	254 86	
Engineering and drafting instruments and tools,	25 52	
Engineering and drafting supplies,	21 44	
Telephone, lighting, heating, water and care of building,	590 14	
Rent and taxes,	480 75	
Miscellaneous expenses,	67 63	
		7,849 25
Construction: —		
Advertising,	$189 57	
Tools, machinery and appliances,	3 50	
Brick, cement, lumber and other field supplies and expenses,	5,851 17	
		6,044 24
Contracts: —		
Rendle-Stoddard Co., Contract 146, for constructing Section 73 of the Reading extension of the North Metropolitan System in Woburn and Stoneham,	$2,639 77	
Rendle-Stoddard Co., Contract 148, for constructing Section 74 of the Reading extension of the North Metropolitan System in Stoneham,	11,883 38	
Antony Cefalo, Contract 4 (new series), for constructing Section 75 of the Reading extension of the North Metropolitan System in Stoneham and Wakefield,	17,824 83	
Amounts carried forward,	$32,347 98	$16,863 35

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$32,347 98	$16,863 35
North System Enlargement — Con.		
Contracts — *Con.*		
Bruno & Petitti, Contract 1 (new series) for constructing part of Section 76 of the Reading extension of the North Metropolitan System in Wakefield and Reading,	54,094 85	
		86,442 83
Real estate: —		
Settlements,	$1,656 00	
Legal, conveyancing and expert,	136 93	
		1,792 93
Total for North Metropolitan System,		$105,099 11
South Metropolitan System.		
High-level Sewer Extensions.		
Administration: —		
Commissioners,	$499 99	
Secretary,	981 00	
Clerks and stenographers,	1,016 25	
Stationery, printing and office supplies,	207 19	
Telephone, lighting, heating, water and care of building,	211 12	
Rent and taxes, main office,	160 24	
Miscellaneous expenses,	3 00	
		$3,078 79
Engineering: —		
Chief engineer,	$416 67	
Engineering assistants,	7,116 90	
Inspectors,	2,737 27	
Traveling expenses,	1,222 45	
Engineering and drafting instruments and tools,	8 60	
Stationery, printing and office supplies,	283 40	
Engineering and drafting supplies,	107 38	
Telephone, lighting, heating, water and care of building,	633 34	
Rent and taxes, main office,	480 75	
Miscellaneous expenses,	269 05	
		13,275 81
Construction: —		
Advertising,	$135 40	
Labor and teaming,	52 00	
Brick, cement, lumber and other field supplies and expenses,	2,226 16	
		2,413 56
Contracts: —		
Thomas Russo & Co., Contract 138, for constructing Section 98 of the Wellesley extension of the high-level sewer in West Roxbury and Dedham. Amount paid in settlement of all claims and demands for materials furnished and money expended on account of said contract, which was abandoned by said company,	$656 77	
Amounts carried forward,	$656 77	$18,768 16

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$656 77	$18,768 16
High-level Sewer Extensions — Con.		
Contracts — *Con.*		
Rowe Contracting Co., Contract 139, for constructing Section 99 (in part) of the Wellesley extension of the high-level sewer in Dedham,	2,500 00	
John P. Cavanagh Co., Contract 149, for constructing Section 99 (in part) of the Wellesley extension of the high-level sewer in Dedham,	3,048 10	
Rendle-Stoddard Co., Contract 3 (new series), for constructing Section 99 (in part) of the Wellesley extension of the high-level sewer in Dedham,	65,911 13	
Bruno & Petitti, Contract 2 (new series), for constructing Section 100 of the Wellesley extension of the high-level sewer in Dedham,	89,517 75	
Rendle-Stoddard Co., Contract 145, for constructing Section 101 of the Wellesley extension of the high-level sewer in Needham and Dedham,	33,202 73	
Bruno & Petitti, Contract 143, for constructing Section 102 of the Wellesley extension of the high-level sewer in Needham,	90 00	
		194,926 48
Real estate: —		
Legal, conveyancing and expert,	$453 00	
Settlements,	38 26	
		491 26
Total for South Metropolitan System,		$214,185 90
Maintenance and Operation of Works.		
North Metropolitan System.		
Administration: —		
Commissioners,	$749 99	
Secretary and assistants,	2,922 82	
Rent,	240 36	
Heating, lighting and care of building,	300 44	
Postage,	60 00	
Printing, stationery and office supplies,	358 12	
Telephones,	46 68	
Traveling expenses,	10 00	
Miscellaneous expenses,	36 70	
		$4,725 11
General supervision: —		
Chief engineer and assistants,	$8,923 23	
Rent,	721 13	
Heating, lighting and care of building,	901 53	
Postage,	44 00	
Printing, stationery and office supplies,	214 71	
Telephones,	140 06	
Traveling expenses,	25 00	
Miscellaneous expenses,	73 15	
		11,042 81
Deer Island pumping station: —		
Labor,	$32,296 03	
Fuel,	51,317 50	
Amounts carried forward,	$83,613 53	$15,767 92

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$83,613 53	$15,767 92
North Metropolitan System — Con.		
Deer Island pumping station — *Con.*		
Oil and waste,	1,183 65	
Water,	1,491 00	
Packing,	390 08	
Repairs and renewals,	1,527 98	
Telephones,	18 10	
General supplies,	981 58	
Miscellaneous supplies and expenses,	305 70	
		89,511 62
East Boston pumping station: —		
Labor,	$37,199 22	
Fuel,	35,859 66	
Oil and waste,	1,116 14	
Water,	2,046 28	
Packing,	35 18	
Repairs and renewals,	802 82	
General supplies,	503 55	
Miscellaneous supplies and expenses,	302 36	
		77,865 21
Charlestown pumping station: —		
Labor,	$23,746 13	
Fuel,	12,495 00	
Oil and waste,	454 22	
Water,	656 28	
Packing,	61 66	
Repairs and renewals,	125 42	
Telephones,	8 60	
General supplies,	261 72	
Miscellaneous supplies and expenses,	96 42	
		37,905 45
Alewife Brook pumping station: —		
Labor,	$11,903 32	
Fuel,	6,702 43	
Oil and waste,	547 86	
Water,	282 48	
Packing,	50 56	
Repairs and renewals,	195 84	
Telephones,	7 20	
General supplies,	72 75	
Miscellaneous supplies and expenses,	306 88	
		20,069 32
Sewer lines, buildings and grounds: —		
Engineering assistants,	$2,515 00	
Labor,	46,951 83	
Automobiles,	436 13	
Brick, cement and lime,	1,402 64	
Castings, ironwork and metals,	2,058 00	
Amounts carried forward,	$53,363 60	$241,119 52

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$53,363 60	$241,119 52
North Metropolitan System — Con.		
Sewer lines, buildings and grounds — *Con.*		
Freight, express and teaming,	3 11	
Fuel and lighting,	118 40	
Jobbing and repairing,	245 55	
Lumber,	1,460 52	
Machinery, tools and appliances,	1,124 43	
Paints and oils,	1,138 13	
Rubber and oiled goods,	206 38	
Sand, gravel and stone,	779 94	
Telephones,	259 25	
Traveling expenses,	929 03	
General supplies,	2,331 47	
Miscellaneous expenses,	506 42	
		62,466 23
Horses, vehicles and stable account,		5,184 63
Payments under industrial accident law and special benefit appropriations,		705 79
Total for North Metropolitan System,		$309,476 17
South Metropolitan System.		
Administration: —		
Commissioners,	$650 00	
Secretary and assistants,	2,544 74	
Rent,	208 32	
Heating, lighting and care of building,	250 75	
Postage,	30 00	
Printing, stationery and office supplies,	361 20	
Telephones,	40 89	
Traveling expenses,	21 35	
		$4,107 25
General supervision: —		
Chief engineer and assistants,	$5,379 34	
Rent,	624 98	
Heating, lighting and care of building,	752 43	
Printing, stationery and office supplies,	176 53	
Telephones,	122 69	
Traveling expenses,	50 00	
Miscellaneous expenses,	1 00	
		7,106 97
Ward Street pumping station: —		
Labor,	$37,188 50	
Fuel,	36,435 05	
Oil and waste,	764 38	
Water,	1,713 72	
Packing,	131 28	
Repairs and renewals,	1,852 83	
Telephones,	15 51	
Amounts carried forward,	$78,101 27	$11,214 22

General Character of Expenditures.	For the Year ending December 31, 1920.	
Amounts brought forward,	$78,101 27	$11,214 22
South Metropolitan System — Con.		
Ward Street Pumping Station — *Con.*		
General supplies,	1,455 13	
Miscellaneous supplies and expenses,	1,704 54	
		81,260 94
Quincy pumping station: —		
Labor,	$13,072 29	
Fuel,	10,916 10	
Oil and waste,	423 38	
Water,	419 29	
Packing,	43 93	
Repairs and renewals,	111 56	
Telephones,	10 85	
General supplies,	293 11	
Miscellaneous supplies and expenses,	62 42	
		25,352 93
Nut Island screen-house: —		
Labor,	$12,110 96	
Fuel,	5,700 00	
Oil and waste,	250 77	
Water,	374 73	
Packing,	14 37	
Repairs and renewals,	81 17	
Telephones,	10 55	
General supplies,	311 38	
Miscellaneous supplies and expenses,	115 39	
		18,969 32
Sewer lines, buildings and grounds: —		
Engineering assistants,	$5,355 45	
Labor,	32,900 69	
Automobiles,	940 90	
Brick, cement and lime,	350 80	
Castings, ironwork and metals,	124 87	
Fuel and lighting,	26 38	
Freight, express and teaming,	55 95	
Jobbing and repairing,	27 25	
Lumber,	175 49	
Machinery, tools and appliances,	405 88	
Paints and oils,	719 04	
Rubber and oiled goods,	309 87	
Sand, gravel and stone,	68 78	
Telephones,	160 20	
Traveling expenses,	1,046 37	
General supplies,	1,438 61	
Miscellaneous expenses,	437 68	
		44,544 21
City of Boston for pumping,		5,869 36
Horses, vehicles and stable account,		3,089 11
Payments under industrial accident law and special benefit appropriations,		526 35
Total for South Metropolitan System,		$190,826 44

(*b*) *Receipts.*

The receipts from the sales of property, from rents and from other sources, have been credited as follows: —

Account.	For the Year ending December 31, 1920.
Construction: —	
North Metropolitan System,	$1,114 99
South Metropolitan System,	141 40
Maintenance: —	
North Metropolitan System,	411 69
South Metropolitan System,	328 66
Sinking fund: —	
North Metropolitan System,	216 64
Interest fund: —	
North Metropolitan System,	55 74
South Metropolitan System,	50 43
	$2,319 55
Amount credited from beginning of work to January 1, 1920,	153,865 56
Total receipts to January 1, 1921,	$156,185 11

(*c*) *Assets.*

The following is an abstract of the assets of the sewerage works, a complete schedule of which is kept on file in the office of the Commission: —

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate connected therewith.

(*d*) *Liabilities.*

There are sundry bills for current expenses which have not yet been received.

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

Name.	Work.	Amount.
North System enlargement: —		
Antony Cefalo,	Contract 4 (new series), Section 75, Reading extension.	$3,145 57
Bruno & Petitti,	Contract 1 (new series), Section 76 (in part), Reading extension.	9,546 15
High-level sewer extensions: —		
Timothy O'Connell,	Contract 57, Section 82 (in part),	60 00
Rendle-Stoddard Co.,	Contract 3 (new series), Section 99 (in part), Wellesley extension.	11,631 37
Bruno & Petitti,	Contract 2 (new series), Section 100, Wellesley extension.	15,797 25
Rendle-Stoddard Co.,	Contract 145, Section 101, Wellesley extension,	5,859 29

Settlements are pending with the following parties for easements taken in lands owned by them: —

Clifford M. Locke, Martha W. Burrage, Edward and Catherine Bingham, Katherine H. Rooney, Mary A. Read, Hannah E. Pond, Richard G. Wadsworth, Frank D. Chase, heirs of Stephen M. Weld, Bear Hill Associates, Herbert M. Hopkins, Joseph E. Hopkins, George A. Forbes, Lawrence Minot and Moses Williams, Trustees, Frederick P. Royce and Francis Peabody, Trustees, Maurice McKenna, Michael Flynn, Sarah A. Brown, John B. Tidd, Cornelius J. Sweeney, Mary A. Scalley, Stoneham Branch Railroad, Elizabeth L. McGrady, Margaret McLaughlin, Annie E. Greene, Estate of Ellen Magner, Richard C. Christie, Carl and Emelia Christiansen, Ida A. Nilsson, Bridget Mary McCarty, Walter Steele, Betty K. Farr, Emma C. and Ruth G. Prescott.

V. OTHER REPORTS.

The detailed reports of the Directors of Parks, Park Engineering, Water and Sewerage, with the usual tables and statistics, are herewith presented. The financial statement of the Parks Division follows the report of the Director of Park Engineering.

Respectfully submitted,

JAMES A. BAILEY,
Metropolitan District Commissioner.

Boston, February 26, 1921.

REPORT OF THE DIRECTOR OF PARKS.

DECEMBER 3, 1920.

Hon. JAMES A. BAILEY, *Commissioner, Metropolitan District Commission, Boston, Mass.*

DEAR SIR: — I herewith submit a brief report on the condition of the metropolitan parks and parkways under my general supervision as Director of Parks.

The usual work of maintenance and upkeep of the various parkways and reservations has been carried on throughout the year, and while there are certain pieces of work which have not been done because of inability to secure necessary labor, the general situation is satisfactory and the work well in hand.

The construction work that was under way in the autumn of 1919 has largely been completed, as you will see by the engineer's report. Other outstanding matters of interest for the year 1920 are as follows: —

At the Blue Hills Reservation the work of removing chestnut trees dying from chestnut tree blight has progressed favorably, but it is a large undertaking. It is fortunate that the work was begun last year, as the ravage of the chestnut tree blight during the past summer has been very rapid. It will require another year and a half to complete this work.

It leaves the reservation in a very denuded and ugly condition, but nature will rapidly assert itself and cover the bare places. The pine trees which have been planted throughout the reservation during the last fifteen years will assist in replacing the chestnut trees.

All the reservations are reasonably free from gypsy moths and other insect pests, with the exception of the Blue Hills Reservation. Here the gypsy moth continues to be a serious menace, but the removal of such a large number of chestnut trees should make the handling of the gypsy moth an easier matter.

The superintendent of the Middlesex Fells Division discovered a new insect pest during the past summer, which we trust will not

become serious. Apparently he was the first person to call the attention of the proper national authorities to this new pest.

The subject which excited the most public interest and discussion was a rule regulating the use of the bath-houses at Nahant, Revere and Nantasket.

For a number of years past the custom of hiring a bathing suit and room in the early forenoon of a hot summer day, leaving one's street clothes in the bath-house, and, having donned the bathing suit, to pass the rest of the day upon the beach, has increased. Naturally this congested the bath-houses, stopped all circulation, gave accommodations to a comparative few, and deprived those who came later of an opportunity to get a sea bath.

To overcome this, a rule was adopted at the beginning of the bathing season of 1920, limiting the use of the room and the bathing suit rented of the Commission to two hours, and subjecting those who disobeyed this rule to the liability of arrest and prosecution. The rule has been in effect throughout the bathing season of 1920, and has proved an entire success. But few cases of prosecution were necessary; the court sustained the reasonableness of the rule, and imposed small fines, which was sufficient to cause obedience to the rule. At no time were the bath-houses congested, and the public as a whole think the rule a reasonable one and approve it.

The bath yards of both the Revere Beach and Nantasket Beach bath-houses, built some twenty years ago of wood, are rapidly decaying. Extensive necessary repairs increase each year, and are at the best but a makeshift.

I recommend that plans be prepared and funds provided to replace these wooden structures with concrete buildings of permanent nature.

At Nantasket Beach a foundation was constructed in the autumn of 1919 at the corner of County Road and Wharf Avenue, with the intention of building a store on this corner. Later this was considered inadvisable.

There is a very distinct demand for a large waiting room at this point, and this foundation should be used for such a building. There is also the necessity for a large sanitary building for men which could be placed in the rear. This, with the women's sanitary building already provided, would make a nice group of buildings.

The Nantasket Beach Hotel, built of wood, deteriorates year by year. It is now nearly fifty years old, and is not a building in

which one can take pride. It seems an anomaly for the Metropolitan District Commission to be, even as landlords, conducting a summer hotel. I recommend that at the termination of the present lease in the autumn of 1922 the upper stories of the hotel be torn down.

The metropolitan park police have done a great deal of valuable work during the past year. It was thought that national prohibition might make it possible to decrease the size of the police force, but experience has shown this to be quite out of the question. The greatly increased number of motor vehicles and the way they are used make it necessary to keep the police force up to its full quota of 150 patrolmen.

The number of band concerts given during the past summer was approximately the same as in previous years, with the exception of Revere Beach, where fewer concerts were given.

For a number of years past the attendance at the various concerts has been decreasing, and the past summer was no exception. I am convinced that the public have lost their interest in band concerts, and that a much fewer number will give as much, or more, pleasure than the large number of concerts given at the present time.

The only place where the concerts seemed to be really enjoyed was at Nantasket.

During the winter of 1920 the Blue Hills street car line from Mattapan to the Blue Hills Reservation ceased operating, and since then there has been no practical way for persons of moderate means to get to this reservation, so that very few people as compared with previous years have used the reservation during the past season. Something should be done to remedy this.

The following matters for which funds have been provided are as yet to be completed: —

Rough grading of Old Colony Parkway; funds partially provided, work temporarily suspended.

Neponset River bridge at Neponset; funds provided, but inadequate because of the excessive price of labor and materials.

Half-tide Dam, Black's Creek, Quincy Shore Reservation; funds provided, but bids excessive.

West Roxbury Parkway bridge across the New Haven Railroad; funds provided, and work to proceed in the spring.

Riprapping, Nahant Beach playground; funds provided.

The following matters are those for which no funds have been provided, but for which there should be appropriations: —

Completion of Furnace Brook Parkway from Newport Avenue to Hancock Street, a short but expensive piece of work which would complete Furnace Brook Parkway.

Winthrop Parkway should be completed and a permanent sea wall provided at the base of the hill and along Short Beach.

An appropriation for the acquiring of land for Hammonds Pond Parkway from Weld Street in West Roxbury to land already acquired in Brookline, and from Beacon Street in Newton to Galen Street bridge, over the Charles River, in Watertown.

The acquiring of this land, particularly in portions of Newton, is especially desirable before expensive buildings are built upon it. The acquiring of land for Lynn Fells Parkway should also be provided for.

The construction of these parkways should be postponed, but the land should be acquired.

Restrictions on shores of Mystic Lake; funds should be provided.

The Cambridge–Somerville boulevard is such an expensive undertaking that it seems inadvisable to consider it at this time, but every year it becomes more of a necessity.

Respectfully submitted,

ELLERTON P. WHITNEY,
Director of Parks.

Metropolitan Park System—Dec. 1, 1920.

		Reservations (Acres).																Parkways (Acres).																		Grand Total Reservations and Parkways (Acres).	Parkways (Miles).																	
		Bunker Hill.	Blue Hills.	Middlesex Fells.	Stony Brook.	Beaver Brook.	Hart's Hill.	Hemlock Gorge.	Charles River.	Mystic River.	Neponset River.	King's Beach and Lynn Shore.	Revere Beach.	Winthrop Shore.	Quincy Shore.	Nantasket Beach.	Total Acres.	Blue Hills.	Woburn.	Middlesex Fells.	Revere Beach.	Mystic Valley.	West Roxbury.	Neponset River.	Fresh Pond.	Lynn Fells.	Furnace Brook.	Nahant Beach.	Hammond Pond.	Old Colony.	Quannapowitt.	Lynnway.	Winthrop.	Dedham.	Alewife Brook.	Total Acres.		Blue Hills.	Woburn.	Middlesex Fells.	Revere Beach.	Mystic Valley.	West Roxbury.	Neponset River.	Fresh Pond.	Lynn Fells.	Furnace Brook.	Nahant Beach.	Hammond Pond.	Old Colony.	Quannapowitt.	Lynnway.	Winthrop.	Dedham.	Alewife Brook.	Total Miles.	
	Cities.																																																					
1	Boston,	6.05	–	–	463.72	–	–	–	177.56	–	146.80	–	–	–	–	–	794.22	.27	–	–	–	–	72.37	22.76	–	–	–	–	–	52.73	–	–	–	21.98	–	170.11	964.33	.015	–	–	–	–	1.510	.72	–	–	–	–	–	2.70	–	–	–	.49	–	5.435	1
2	Cambridge,	–	–	–	–	–	–	–	43.84	–	–	–	–	–	–	–	43.84	–	–	–	–	–	–	–	12.40	–	–	–	–	–	–	–	–	–	86.38	98.78	142.62	–	–	–	–	–	–	–	.520	–	–	–	–	–	–	–	–	1.563	2.083	2
3	Chelsea,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	21.21	–	–	–	–	–	–	–	–	–	–	–	–	–	21.21	21.21	–	–	–	–	.814	–	–	–	–	–	–	–	–	–	–	–	.814	3
4	Everett,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	31.26	–	–	–	–	–	–	–	–	–	–	–	–	–	31.26	31.26	–	–	–	1.662	–	–	–	–	–	–	–	–	–	–	–	1.662	4
5	Lynn,	–	–	–	–	–	–	–	–	–	–	19.59	–	–	–	–	19.59	–	–	–	–	–	–	–	–	–	–	.32	–	–	–	–	–	–	32	19.91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.120	5
6	Malden,	–	–	59.53	–	–	–	–	–	–	–	–	–	–	–	–	59.53	–	–	23.58	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23.58	83.11	–	–	1.515	–	–	–	–	–	–	–	–	–	–	–	–	–	1.515	6
7	Medford,	–	–	664.17	–	–	–	–	–	42.37	–	–	–	–	–	–	706.54	–	–	44.50	8.10	265.34	–	–	–	–	–	–	–	–	–	–	–	–	318.00	1,024.54	–	–	2.850	.482	4.45	–	–	–	–	–	–	–	–	–	–	–	7.782	7
8	Melrose,	–	–	177.54	–	–	–	–	–	–	–	–	–	–	–	–	177.54	–	–	–	–	–	–	–	–	7.57	–	–	–	–	–	–	–	–	7.57	185.11	–	–	–	–	–	–	–	–	1.000	–	–	–	–	–	–	–	1.000	8
9	Newton,	–	–	–	–	–	–	4.24	.25	–	–	–	–	–	–	–	190.40	–	–	–	–	–	–	–	–	–	–	–	114.50	–	–	–	–	–	114.50	304.09	–	–	–	–	–	–	–	–	–	–	–	1.20	–	–	–	–	1.200	9
10	Quincy,	–	2,562.57	–	–	–	–	–	–	–	–	–	–	–	32.91	–	2,595.48	–	–	–	–	–	–	–	–	–	101.25	–	–	2.47	–	–	–	–	103.72	2,699.20	–	–	–	–	–	–	–	–	4.320	–	–	–	.30	–	–	–	4.620	10
11	Revere,	–	–	–	–	–	–	–	–	–	–	–	64.99	–	–	–	64.99	–	–	–	66.31	–	–	–	–	–	–	–	–	–	–	5.15	7.91	–	70.37	144.36	–	–	–	2.295	–	–	–	–	–	–	–	–	.88	–	–	3.745	11
12	Somerville,	–	–	–	–	–	–	–	4.03	–	–	–	–	–	–	–	4.03	–	–	13.08	–	4.95	–	–	–	–	–	–	–	–	–	–	–	0.07	28.90	32.03	–	–	.740	–	.38	–	–	–	–	–	–	–	–	–	–	.303	1.423	12
13	Waltham,	–	–	–	–	42.77	–	–	.68	–	–	–	–	–	–	–	81.45	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	81.45	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13
14	Woburn,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	22.64	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	22.64	22.64	–	1.31	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.310	14
	Towns.																																																				
15	Arlington,	–	–	–	–	–	–	–	–	7.83	–	–	–	–	–	–	7.83	–	–	–	–	17.40	–	–	–	–	–	–	–	–	–	–	–	28.10	45.50	53.33	–	–	–	–	1.40	–	–	–	–	–	–	–	–	–	–	.848	2.248	15
16	Belmont,	–	–	–	–	15.56	–	–	–	–	–	–	–	–	–	–	15.56	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20.43	20.43	35.99	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.473	.473	16
17	Braintree,	–	67.84	–	–	–	–	–	–	–	–	–	–	–	–	–	67.84	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	67.84	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	17
18	Brookline,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	69.10	–	–	–	–	–	69.19	69.19	–	–	–	–	–	–	–	–	–	–	–	.80	–	–	–	–	.800	18
19	Canton,	–	471.34	–	–	–	–	–	–	–	264.20	–	–	–	–	–	735.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	735.60	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19
20	Cohasset,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	20
21	Dedham,	–	–	–	–	–	–	–	–	–	234.54	–	–	–	–	–	234.54	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15.16	–	15.16	249.70	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.49	–	.490	21
22	Dover,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	22
23	Hingham,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23
24	Hull,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	25.50	25.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	25.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	24
25	Milton,	–	1,547.68	–	–	–	–	–	–	–	270.33	–	–	–	–	–	1,818.01	83.31	–	–	–	–	–	61.35	–	–	–	–	–	–	–	–	–	–	134.66	1,952.67	2.250	–	–	–	–	1.540	–	–	–	–	–	–	–	–	–	–	3.790	25
26	Nahant,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	81.66	–	–	–	–	–	81.66	81.66	–	–	–	–	–	–	–	–	–	–	2.230	–	–	–	–	–	2.230	26
27	Needham,	–	–	–	–	–	–	14.24	–	–	–	–	–	–	–	–	14.24	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14.24	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	27
	[Randolph],	–	257.00	–	–	–	–	–	–	–	–	–	–	–	–	–	257.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	257.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	28
28	Saugus,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	29
29	Stoneham,	–	–	682.60	–	–	–	–	–	–	–	–	–	–	–	–	682.60	–	–	–	–	–	–	–	–	.15	–	–	–	–	–	–	–	–	.15	682.75	–	–	–	–	–	–	–	–	.060	–	–	–	–	–	–	–	.060	29
30	Swampscott,	–	–	–	–	–	–	–	–	–	–	3.10	–	–	–	–	3.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	30
31	Wakefield,	–	–	–	–	–	22.07	–	–	–	–	–	–	–	–	–	22.07	–	–	–	–	–	–	–	–	–	–	–	–	13.47	–	–	–	–	13.47	36.44	–	–	–	–	–	–	–	–	–	–	–	–	.774	–	–	–	–	.774	31
32	Watertown,	–	–	–	–	–	–	–	79.17	–	–	–	–	–	–	–	79.17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	79.17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	32
33	Wellesley,	–	–	–	–	–	–	4.58	66.07	–	–	–	–	–	–	–	70.65	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	70.65	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	33
34	Weston,	–	–	–	–	–	–	–	117.94	–	–	–	–	–	–	–	117.94	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	117.94	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	34
35	Westwood,	–	–	–	–	–	–	–	–	–	0.57	–	–	–	–	–	6.57	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6.57	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	35
36	Weymouth,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	36
37	Winchester,	–	–	261.93	–	–	–	–	–	–	–	–	–	–	–	–	261.93	–	.60	–	–	50.20	–	–	–	–	–	–	–	–	–	–	–	–	50.80	312.73	–	.07	–	–	1.780	–	–	–	–	–	–	–	–	–	–	1.850	37
38	Winthrop,	–	–	–	–	–	–	–	–	–	–	–	–	16.83	–	–	16.83	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.13	–	–	.13	16.96	–	–	–	–	–	–	–	–	–	–	–	–	–	.02	–	–	.020	38
		6.05	4,006.43	1,845.77	463.72	58.33	22.97	23.06	709.51	54.23	922.50	22.69	64.99	16.83	32.91	25.50	9,175.67	83.58	23.24	82.12	126.88	337.89	72.37	74.11	12.40	7.72	101.25	81.98	183.69	55.20	13.47	5.15	8.04	37.11	144.88	1,451.11	10,620.78	2.265	1.38	5.105	5.253	8.01	1.510	2.200	.520	1.120	4.320	2.230	2.00	3.00	.774	.690	.90	.98	3.187	45.564	

REPORT OF THE DIRECTOR OF PARK ENGINEERING.

November 24, 1920.

Hon. James A. Bailey, *Commissioner, Metropolitan District Commission.*

Dear Sir: — I beg to submit the following report of the work done under the direction of the engineering department of the Parks Division for the year ending November 30, 1920.

Parkways.

Alewife Brook Parkway.

Construction of loam planting strips and sidewalks along the northerly section, formerly Powder House boulevard. Work was done by the forces of the Division.

Blue Hills Parkway.

Section of westerly or traffic roadway from Eliot Street to Brook Road resurfaced with bituminous concrete pavement under contract with Warren Brothers Company, Boston. Work was begun on August 24, 1920, and completed on September 4, 1920. Road was opened to public travel on September 4, 1920.

Dedham Parkway.

Preparation of plans of land to be conveyed by Tierney & Mullin for westerly section of the parkway.

Plans and estimates for construction of above section.

Grading of westerly section was done under contract with Powers Brothers, Brockton, Mass. About 5,000 cubic yards of material were excavated by steam shovel and moved for grading in another section of the parkway.

Work of surfacing roadway and finishing slopes has been in progress by forces of the Division.

It is expected to complete the surfacing in the spring, so that the parkway may be opened to public travel if desired.

Furnace Brook Parkway.

The work of grading and finishing section of Furnace Brook Parkway from Adams Street to Hancock Street under contract with Coleman Brothers, and which was in progress last fall, was suspended during the winter months. The work was resumed in April, 1920, and completed on August 10, 1920. The parkway was opened to public travel on August 14, 1920.

The funds available permitted of the construction of only a temporary surface, the subgrade material being raked, rolled and oiled.

Plans and estimates for construction of dam and tide gates at Black's Creek bridge have been prepared. The purpose of the construction of the dam is to retain the tidal waters in the large basin above Black's Creek bridge at an elevation slightly above half tide, so that the flats may be covered at all times, and boating and bathing facilities provided in the basin.

Bids for this work were received on September 22, 1920, the lowest of which was considerably in excess of the engineer's estimates and in excess of the appropriation. All bids were rejected.

Lynn Fells Parkway.

Steel bridge, carrying the Boston & Maine Railroad over the parkway, has been painted under contract with Maurice M. Devine for furnishing labor, equipment and tools.

Middlesex Fells Parkway.

The section of the easterly or traffic road of Middlesex Fells Parkway from Wellington bridge to Revere Beach Parkway has been resurfaced with Portland cement concrete pavement. The work was done under contract with Simpson Brothers Corporation, and was laid by the "Hassam" method. The work was begun on September 9, 1920, and completed on October 19, 1920. The road was opened to traffic on October 22, 1920.

The bridge over the Boston & Maine Railroad, Medford branch, has been painted under contract with Maurice M. Devine.

Mystic Valley Parkway.

The section of Aberjona River known as Wedgemere Pond, between Bacon Street and the Boston & Maine Railroad, which has been considered in unsanitary condition on account of shoaling, has been dredged by hydraulic process. A small plant has been assembled, partly with equipment belonging to the Commission, and partly with hired equipment, and the soft material pumped from the bed of the river and collected behind dikes in the shallow area. This dredging provides a depth of about 4 feet in the water areas, and fills the flats to an elevation well above the normal height of the water. This work was begun on August 24, 1920, and completed on November 20, 1920.

A section of Mystic Valley Parkway, about 1,500 feet long, has been resurfaced with bituminous macadam by the forces of the Division.

Old Colony Parkway.

Construction plans and specifications for the permanent Neponset bridge have been completed, and bids for the work were received on April 28, 1920. The bids were for alternative designs, both arch type and concrete girder type bridge. Four bids were received for the arch type and five for the girder type. The costs of each type were substantially the same, but the prices bid were about 50 per cent above the estimated cost, and about 75 per cent in excess of the appropriation. The excessive prices bid were evidently due to the high cost of materials and labor and unsettled conditions at the time bids were obtained. All bids were rejected.

The temporary Neponset bridge has been repaired by laying new floor sheathing over its entire length.

Lumber and piles removed from the old Neponset bridge and stored on the southerly bank of the river have been sold as second-hand material to the highest bidder, Aberthaw Construction Company.

On account of refusal of the Public Works Department of the Commonwealth to grant a license to this Commission to fill in tidewater and construct a culvert near Fox Point, Savin Hill, the work of filling with ashes and rubbish has been abandoned, and the contract with the Boston Development and Sanitary Company canceled on March 23, 1920.

On account of a complaint of the Boston Health Department of stagnant water on land of the Commonwealth, Old Colony Parkway, near junction of Mount Vernon Street and Columbia Road, it was necessary to do additional filling to remedy the condition. In November, 1920, another contract was made with the Boston Development and Sanitary Company to furnish ashes and rubbish for filling for this work, on the same terms and conditions as the previous contract.

Revere Beach Parkway.

Considerable repair work has been done on the railroad bridges and bridge over the Malden River, and all steel work painted. The work was done under contract with Lawler Brothers for the carpenter work, and Maurice M. Devine for the painting.

West Roxbury Parkway.

Work of constructing the parkway from Washington Street to Belgrade Avenue, which was begun on September 5, 1919, under contract with Rowe Contracting Company, was suspended during the winter months. Work was resumed on April 8, 1920, and completed on October 16, 1920. The section from Washington Street to Anawan Avenue was opened to public travel on September 7, 1920.

Plans and specifications for the construction of the parkway from Belgrade Avenue to Centre Street, including bridge over the New York, New Haven & Hartford Railroad, have been completed, and were transmitted to the railroad company on July 12, 1920, for their approval of the bridge plans. Approval has not yet been received.

Winthrop Parkway.

The work of building sea wall and grading section of Winthrop Parkway from Ocean Avenue to Endicott Street, under contract with Coleman Brothers, was begun in September, 1919, and substantially completed by the first of the year. A few details of finishing were postponed until the spring on account of the unfavorable conditions. The work was finally completed on May 20, 1920.

Reservations.

Blue Hills Reservation.

The work of making survey and plans for road from Administration Road to the summit of Chickatawbut Hill is in progress.

Bunker Hill Reservation.

Specifications were prepared and bids received for the repointing of the joints of the masonry of Bunker Hill Monument throughout its entire height. The contract was awarded to the lowest bidder, W. L. Waples Company, and the work was begun on June 11, 1920, and completed on September 27, 1920. All joints were cut out by pneumatic tools and repointed with waterproof Portland cement pointing. The roof joints were repointed by caulking with lead wool.

Plans and specifications for the work of grading and surfacing for the restoration of the Bunker Hill Monument grounds have been prepared, and bids were received on August 11, 1920. Contract was made with James H. Fannon, the lowest bidder. The work was begun on September 7, 1920, and completed on November 18, 1920.

The funds available were not sufficient to do all the work necessary as recommended by the landscape architect and the engineer, and it is estimated that about $10,000 additional will be required.

Charles River Reservation, Lower Basin.

The work of rough grading the proposed drives along the southerly bank of the river from North Harvard Street to Western Avenue has been in progress. The material was furnished by the Cambridge Electric Light Company and the Cambridge Gas Light Company at no expense to the Commonwealth.

Repairs to damage by leakage of surface water through the roof of the underground comfort station on Charles River Embankment have been made by waterproofing the outside of the roof and replastering a portion of the interior.

Estimates have been prepared of the cost of repairing and maintaining the park roads along the river in Cambridge, with a view to their transfer to this Commission, under authority of chapter 509 of the Acts of 1920.

Charles River Reservation, Upper Division.

The work of constructing Nonantum Road extension to Maple Street, Newton, under contract with A. G. Tomasello, was begun on August 28, 1919, and suspended during the winter season. The work was resumed on April 1, 1920, and completed on June 30, 1920. The parkway was opened to public travel on July 13, 1920.

Since the completion of this road the city of Newton has widened Maple Street which connects directly with the end of the river drive. This widening of Maple Street necessitates a slight widening at the end of Nonantum Road, and negotiations have just been completed for the acquirement of the necessary land from the abutting owner by the city of Newton for the Commonwealth. The land is provided by the city of Newton with the understanding that this Commission will do the work of widening the entrance.

Papers have been passed for exchange of land between the United States War Department and the Commonwealth. The War Department has conveyed to the Commonwealth the area south of the Watertown Arsenal grounds, including North Beacon Street from the river to the Charles River Road, Watertown, in exchange for marsh land north of Arsenal Street on the westerly side of the river.

Lynn Shore Reservation.

Work of repairs to sea wall has been carried on as far as the funds available would permit. The work consists of building concrete toe wall along the old concrete wall, where the masonry has disintegrated.

On account of the excessively high costs of labor and materials, only a small section of the work could be completed with the amount appropriated, which was $5,000. There still remains considerable of this repair work to be done, and an item of $10,000 has been included in next year's budget.

Middlesex Fells Reservation.

The work of widening, straightening and improving South Border Road so that it might be safe for motor car travel, has been in progress by the forces of the Division, with the exception of rock excavation, which was done under contract with John A. Gaffey.

The original roadway surfacing was retained, except that the gravel surface was treated with asphaltic oil and sanded.

This road, from Mystic Valley Parkway, Winchester, to Forest Street, Medford, was opened to motor traffic on August 7, 1920.

A section of Woodland Road has been resurfaced with bituminous macadam by the forces of the Division.

Nantasket Beach Reservation.

Considerable work has been done by the forces of the Division toward the replacing of temporary wooden structures with concrete, thereby diminishing the cost of maintenance.

The wooden promenade, between the hotel and the Tivoli shelter, has been replaced by a retaining wall and solid filling.

Concrete curbs and steps have been built along the front of the pavilion. Concrete surface and curb have been built in the café and laundry courtyard. The sewerage system has been extended from the hotel to the bath-house.

It has been customary for a great number of cars to park on the area south of the bath-house, and as the surface of this area is of a sandy nature, great difficulty is encountered in going in and out. Contract has just been made with John Smith, the lowest bidder, to furnish clay with which to cover the sand. This will provide a better surface and give greater facilities for parking.

Winthrop Shore Reservation.

The work of repairs of damage to sea wall, sidewalks, roadways and fences caused by the storm of last November, which was started immediately after the storm, has been completed. The work was done under contract with Coleman Brothers, and included the rebuilding of some of the granite masonry wall, resetting of granite coping, rebuilding of concrete sidewalks, pointing of joints in the masonry, and resetting of fences; also, twelve flights of wooden steps have been replaced.

Repairs have been made to the bridge over the Boston, Revere Beach & Lynn Railroad. The work of repairs to steel work was done by the Boston Bridge Works, and the wood work by Lawler Brothers.

Drawbridges and Locks.

The work of maintenance and operation of locks, sluices and drawbridge at Charles River Dam has been under the direction and supervision of this Department. In July, 1920, the operating force was reduced from 34 to 26 men. The work of ice breaking in the Charles River Basin and Broad and Lechmere canals, during the winter season of 1919–20, was exceptionally heavy on account of the severe weather. The boat owned by the Commission was able to keep the channels clear generally, by working two and three shifts. On a few occasions, when the boat was out of commission for a short time for repairs, outside assistance was obtained from the towboat companies. Extensive repairs were necessary to the boat after the winter's work, but she is now in first-class condition for work for the coming winter season.

Extensive repairs have been made to the Saugus River bridge under contract with Lawler Brothers for furnishing labor and tools. The work has included the rebuilding of the entire floor of the drawbridge.

Similar repairs have been made to the Malden River bridge.

Necessary repairs have been made and painting done on Wellington bridge by the bridge division forces. Extensive repairs will be necessary next year on the floors of the drawbridge, and some of the materials for this work have already been purchased.

The work of maintenance and operation of the above-mentioned bridges and the Neponset temporary bridge and Cradock Lock have been under the direction of this Department.

The following is a record of the traffic through the locks and drawbridges during the year: —

Charles River Dam and Locks.

Main Lock.

Number of openings,	3,716
Number of vessels,	3,291
Number of small boats, etc.,	2,712
Lumber (feet B. M.),	1,388,200
Coal (tons),	217,582
Oil (barrels),	384,500
Sand (tons),	141,345
Gravel (tons),	62,159

Empty barrels,	20,502
Rubble stone (tons),	5,135
Granite (tons),	4,779
Piling (feet B. M.),	207,000
Piles,	1,220
Water (tons),	925

There were 2,258 drawbridge openings.

Wellington Bridge.

Number of openings,	76
Number of vessels,	98

Malden River Bridge.

Number of openings,	450
Number of vessels,	815

Saugus River Bridge.

Number of openings,	199
Number of vessels,	270

Cradock Lock.

Number of openings,	701
Number of boats,	1,071
Number of boats over rollway,	90

Temporary Neponset Bridge.

Number of openings,	433
Number of vessels,	703

General.

Work of road repairs and maintenance in the various divisions has been done by the forces of the Division under the supervision and direction of this Department, and generally consists of surface treatments with tar and asphaltic oil, and patching with these same materials.

On account of increased cost of street lighting by naphtha lamps, the lighting has been discontinued in sections of the parkways which are located through unsettled districts and where few pedestrians travel at night. Three hundred and fifty-one lamps have been discontinued.

Notice has been received of the further increase in cost for the coming year of the naphtha lamps, and the substitution of electric

lighting systems for the naphtha lamps still operated seems advisable.

All bridges under care and control of this Commission have been inspected twice during the year, and report made with recommendations and estimates of cost of repairs.

This Department has issued permits for various work in the parkways and reservations, and supervised and inspected the work.

Numerous surveys have been made for the establishment of restriction and boundary lines where building operations are in progress on abutting land.

Very truly yours,

JOHN R. RABLIN,
Director of Park Engineering.

Dec. 1, 1920.

TABLE 1. — DATA RELATING TO METROPOLITAN PARK SYSTEM.

Areas of Reservations and Parkways.

	Acres.	
Reservations: —		
Blue Hills,	4,906.43	
Bunker Hill,	6.05	
Middlesex Fells,	1,845.77	
Stony Brook,	463.72	
Beaver Brook,	58.33	
Hart's Hill,	22.97	
Hemlock Gorge,	23.06	
Charles River,	709.51	
Mystic River,	54.23	
Neponset River,	922.59	
King's Beach and Lynn Shore,	22.69	
Revere Beach,	64.99	
Winthrop Shore,	16.83	
Quincy Shore,	32.91	
Nantasket Beach,	25.59	
Total,		9,175.67
Parkways: —		
Hammond Pond,	183.69	
Blue Hills,	83.58	
Old Colony,	55.20	
Woburn,	23.24	
Middlesex Fells,	82.12	
Revere Beach,	126.88	
Mystic Valley,	337.89	
Neponset River,	74.11	
Fresh Pond,	12.40	
Lynn Fells,	7.72	
Furnace Brook,	101.25	
Nahant Beach,	81.98	
Lynnway,	5.15	
Winthrop,	8.04	
Dedham,	37.14	
Alewife Brook,	144.88	
West Roxbury,	72.37	
Quannapowitt,	13.47	
Total,		1,451.11
Grand total, reservations and parkways,		10,626.78

Lengths of Formal Roads constructed.

Reservations: —	Double Roadways (Miles).	Single Roadways (Miles).	Total (Miles).
Charles River,	–	5.28	
Lynn Shore,	–	.96	
Quincy Shore,	–	2.24	
Revere Beach,	–	2.70	
Stony Brook,	–	2.34	
Winthrop Shore,	–	1.07	
			14.69
Parkways: —			
Alewife Brook,	–	.70	
Blue Hills,	1.46	1.61	
Fresh Pond,	–	.50	
Furnace Brook,	–	4.06	
Lynn Fells,	–	1.05	
Lynnway,	–	.68	
Middlesex Fells,	4.10	1.77	
Mystic Valley,	–	6.17	
Nahant Beach,	–	.50	
Neponset River,	–	.53	
Revere Beach,	1.45	3.73	
West Roxbury,	–	.83	
Winthrop,	–	.49	
Woburn,	–	1.38	
			24.00
	7.01*		
*Equivalent in miles of single roadway,			14.02

Highways transferred by or taken from cities and towns: —	Miles.	
Alewife Brook Parkway,	.44	
Blue Hills Reservation,	1.23	
Charles River Reservation,	.39	
Middlesex Fells Reservation,	6.63	
Nantasket Beach Reservation,	.71	
		9.40
Grand total,		62.11

All above roads open to automobile traffic.

Lengths of Carriage Roads in Reservations.

	Miles.
Blue Hills Reservation,	30.93
Middlesex Fells Reservation,	17.85
Stony Brook Reservation,	1.60
Beaver Brook Reservation,	.22
Charles River Reservation,	3.70
Total,	54.30

Of the above roads 10.19 miles are open to automobile traffic.

Lights in Parkways and Reservations.

	Lights.
Alewife Brook Parkway (arc lights),	8
Blue Hills Parkway (Welsbach gas),	80
Charles River Reservation, Upper Division, Soldiers' Field Road, Arsenal Road and North Beacon Street (electric),	16
Charles River Reservation, Boston Embankment (electric),	106
Charles River Reservation, Lower Basin, Dam and Lock (electric),	16
Fresh Pond Parkway (electric),	15
Furnace Brook Parkway (Welsbach gas),	[1] 45
Lynn Fells Parkway (Welsbach naphtha),	17
Lynn Shore Reservation (electric),	28
Lynnway (electric),	10
Middlesex Fells Parkway (Welsbach naphtha),	262
Middlesex Fells Reservation (Welsbach naphtha),	29
Middlesex Fells Reservation (electric),	48
Mystic Valley Parkway (Welsbach naphtha),	52
Nahant Beach Parkway (electric),	[2] 7
Nantasket Beach Reservation (electric),	[3, 4] 30
Old Colony Parkway (arc),	3
Quincy Shore Reservation (Welsbach gas),	[5] 56
Quincy Shore Reservation (electric),	3
Revere Beach Parkway (Welsbach naphtha),	165
Revere Beach Parkway (arc),	5
Revere Beach Reservation (Welsbach gas),	53
Revere Beach Reservation (electric),	[6] 36
Winthrop Parkway (Welsbach naphtha),	6
Winthrop Shore Reservation (electric),	7
Total,	1,103

[1] Eighty-six lights to October 1.
[2] Five additional lights in summer.
[3] Twenty additional lights in summer.
[4] Three additional lights in summer south of bath-house, near wall.
[5] Seventy-eight lights to October 1.
[6] Three hundred and forty-eight additional lights in summer.

Miles of Seashore.

	Miles.
Lynn Shore,	1.50
Nahant Beach,	3.92
Revere Beach,	2.74
Winthrop Shore,	1.71
Nantasket Beach,	1.02
Quincy Shore,	2.19
Total,	13.08

Lengths of Sea Walls.

	Miles.
Lynn Shore,	1.30
Revere Beach at Northern Circle,	.08
Revere Beach at Eliot Circle,	.15
Revere Beach, shore protection, bath-house shelter to Revere Street shelter,	.29
Revere Beach, shore protection, south of Northern Circle,	.28
Winthrop Shore, bridge to Great Head,	1.04
Winthrop Shore, bridge to Grover's Cliff,	.23
Quincy Shore Reservation, southerly end,	.15
Nantasket Beach Reservation,	.43
Winthrop Parkway, near Leverett Avenue, Revere,	.12
Total,	4.07

Miles of River Bank.

	Miles.
Charles River,	28.58
Mystic River,	8.16
Neponset River,	15.86
Alewife Brook,	4.50
Total,	57.10

Bridges.

Reinforced concrete bridges,	11
Steel bridges,	8
Wooden bridges,	[1]5
Drawbridges,	5
Footbridges,	12
Total,	41

Culverts.

Reinforced concrete and other masonry culverts,	37

[1] One-half of Wellington bridge rebuilt with concrete girders.

Dams.

Beaver Brook Reservation, small wooden dams,	2
Charles River Reservation, Charles River Basin tidal dam, 1,200 feet in length,	1
Charles River Reservation, small stone dam in branch below Washington Street, Newton Lower Falls,	1
Charles River Reservation, reinforced concrete dam at Washington Street, Newton Lower Falls, 200 feet in length,	1
Hemlock Gorge Reservation, small stone masonry dam with stop planks, in gorge,	1
Hemlock Gorge Reservation, small reinforced concrete dam on East Branch of river, Newton Upper Falls,	1
Hemlock Gorge Reservation, reinforced concrete dam in Charles River at Boylston Street, Newton Upper Falls, 90 feet in length,	1
Mystic River Reservation, reinforced concrete tidal dam at Cradock bridge, 100 feet in length; weirs, 400 feet in length,	1
Total,	9

Lock Gates, Sluice Gates and Tide Gates.

Charles River Reservation, Charles River Basin tidal dam, 6 lock gates, 13 sluice gates, 43 tide gates.
Mystic River Reservation, Cradock bridge tidal dam, 2 lock gates, 4 sluice gates, 8 tide gates.
Quincy Shore Reservation, 8 tide gates.
Revere Beach Parkway, 1 tide gate.

Police Signal System.

	Miles.
Blue Hills Division,	30½
Middlesex Fells Division,	18¼
Nantasket Beach Division,	2½
Charles River Reservation,	10
Fresh Pond Parkway,	½
Total,	61¾

Revere Beach Division police signal system, serving 11 miles of parkways and reservations, and Middlesex Fells Division, serving 1½ miles of parkway, on wires leased from the New England Telephone and Telegraph Company. Two miles of wire in Blue Hills Reservation leased from the New England Telephone and Telegraph Company.

Buildings.

	Hammond Pond Parkway.	Blue Hills.	Middlesex Fells.	Revere Beach.	Charles River Reservation.		Nantasket Beach.	Beaver Brook.	Totals.
					Lower Basin.	Upper Division.			
Police stations,	–	1	1	2	–	2	1	–	7
Substations,	1	5	2	3	2	1	–	–	14
Separate work, headquarters,	–	–	1	1	–	–	–	–	2
Stables,	–	5	3	2	1	3	1	1	16
Superintendents' houses,	–	1	–	1	–	1	–	1	4
Dwellings,	–	8	3	–	–	2	2	–	15
Garages,	–	4	2	2	1	1	1	–	10
Carpenter shops,	–	1	1	1	–	1	–	–	4
Paint shops,	–	–	1	1	1	–	1	–	4
Other shops,	–	–	3	2	–	4	1	–	10
Sheds,	–	2	6	3	1	–	–	–	12
Miscellaneous,	–	3	12	4	5	4	4	2	34
Band stands,	–	2	3	3	1	6	1	1	17
Shelters,	–	8	1	4	1	1	1	1	17
Refectories,	–	2	–	–	1	–	–	–	3
Hotel,	–	–	–	–	–	–	1	–	1
Sanitaries,	–	3	6	2	1	4	7	1	24
Boathouses,	–	–	–	1	1	6	–	–	8
Bath-houses,	–	3	2	2	–	3	1	–	11
Laundries,	–	–	–	1	–	–	1	–	2
Coal bin,	–	–	–	–	–	–	1	–	1
									216

Table 2. — Summary of Cost of Road Repairs and Maintenance, 1920.

PARKWAY OR RESERVATION.	Length (Feet).	Width of Roadway (Feet).	Square Yards.	Cost per Square Yard in Detail.							Total Amount.	Remarks.	Location.
				Labor (Cents).	Broken Stone (Cents).	Sand (Cents).	Bituminous Binder or Dust Layer. Kind of Material.	Gallons per Square Yard.	Cost (Cents).	Total Cost (Cents).			
Blue Hills Parkway, .	3,900	26	11,266	1.73	3.26	–	Tarvia "A" (Barrett Manufacturing Company).	.20	2.19	7.18	$808 41	Surface treatment.	Canton Avenue to Blue Hill Terrace, Traffic Road, Milton.
Blue Hills Parkway, .	826	26	2,508	–	–	–	Warrenite Bitulithic, .	–	–	280.60	7,037 49	Reconstruction,	Elliot Street to Brook Road, Traffic Road, Milton.
Blue Hills Parkway, .	1,000	26	2,889	15.67	17.31	–	Tarvia X, . . .	.37	5.32	38.30	1,106 49	Resurfacing, .	From Canton Avenue, northerly, Traffic Road, Milton.
Blue Hills Reservation,	6,800	16[1]	6,044	1.30	–	–	Asphaltic Oil No. 6, .	.29	4.91	6.21	375 46	Surface treatment.	Wampatuck Road, Furnace Brook Parkway, to Administration Road, Quincy.
Blue Hills Reservation,	7,000	16[1]	6,222	1.24	–	–	Asphaltic Oil No. 6, .	.32	4.84	6.08	378 47	Surface treatment.	Administration Road, Wampatuck Road to Randolph Avenue, Milton.
Blue Hills Reservation,	6,500	16[1]	5,777	1.36	–	–	Asphaltic Oil No. 6, .	.40	6.28	7.64	441 46	Surface treatment.	Border Road, Randolph Avenue to Hillside Street, Milton.
Blue Hills Reservation,	6,500	16[1]	5,777	1.36	–	–	Asphaltic Oil No. 6, .	.34	5.57	6.93	400 22	Surface treatment.	Hillside Street, Milton.
Blue Hills Reservation,	4,000	19	8,445	3.46	–	–	Asphaltic Oil No. 6, .	.41	5.86	9.32	787 28	Surface treatment.	Unquity Road, Hillside Street to Blue Hills Parkway, Milton.
Charles River Reservation.	9,200	60 & 40	55,500	.63	–	.71	Tarine No. 1 (American Tar Company).	.19	2.61	3.95	2,190 20	Surface treatment.	Soldiers Field Road, Brighton.
Charles River Reservation.	3,100	40	13,777	.92	–	.85	Asphaltic Oil No. 6, .	.15	2.18	3.95	544 87	Surface treatment.	Charles River Road, Arsenal Street to North Beacon Street, Watertown.
Charles River Reservation.	5,400	26 & 36	16,211	.78	–	1.21	Asphaltic Oil No. 6, .	.25	3.70	5.69	922 30	Surface treatment.	Charles River Road, North Beacon Street to Watertown Square, Watertown.
Charles River Reservation.	4,700	12	6,267	1.23	–	.57	Asphaltic Oil No. 4, .	.31	4.64	6.44	403 33	Surface treatment.	Forest Grove Road, Waltham and Newton.
Charles River Reservation.	9,300	13	13,433	1.39	–	.96	Asphaltic Oil No. 4 and No. 6.	.35	5.31	7.66	1,028 90	Surface treatment.	Quinobequin Road, Newton.
Charles River Reservation.	5,500	16	9,778	1.51	–	1.04	Asphaltic Oil No. 4 and No. 6.	.16	2.44	4.99	487 90	Surface treatment.	Norumbega Road, Weston.
Fresh Pond Parkway,	2,700	40	12,000	1.13	–	1.00	Asphaltic Oil No. 6, .	.17	2.50	4.63	555 35	Surface treatment.	Mt. Auburn Street to Huron Avenue, Cambridge.

[1] Full width of road not treated.

TABLE 2.—SUMMARY OF COST OF ROAD REPAIRS AND MAINTENANCE, 1920—*Concluded.*

PARKWAY OR RESERVATION.	Length (Feet).	Width of Roadway (Feet).	Square Yards.	Cost per Square Yard in Detail.							Total Amount.	Remarks.	Location.
				Labor (Cents).	Broken Stone (Cents).	Sand (Cents).	Bituminous Binder or Dust Layer.			Total Cost (Cents).			
							Kind of Material.	Gallons per Square Yard.	Cost (Cents).				
Furnace Brook Parkway.	4,000	20	8,889	8.32	–	–	Tarine No. 1, . .	.79	11.43	19.75	1,755 50	Surface treatment.	Fenno Street to Black's Creek Bridge, Quincy.
Lynn Shore Reservation.	560	40	2,500	28.66	42.26	–	Tarvia X, . . .	2.06	29.89	100.81	2,520 23	Reconstruction,	Wave Street to Atlantic Terrace, Lynn.
Middlesex Fells Parkway.	500	36	2,000	58.15	55.97	–	Bermudez Road Asphalt (Barber Asphalt Company).	1.55	38.44	152.56	3,051 29	Reconstruction,	Fells Avenue to Salem Street, northerly roadway, Medford.
Middlesex Fells Parkway.	1,475	27	4,775	–	–	–	Hassam compressed concrete road.	–	–	365.00	17,428 75	Reconstruction,	Wellington bridge to Revere Beach Parkway, Medford.
Middlesex Fells Reservation.	1,650	20 & 24	3,867	31.79	88.93	–	Bermudez Road Asphalt,	1.68	41.69	162.41	6,280 28	Reconstruction,	Woodland Road, south of sanitarium, Medford and Stoneham.
Middlesex Fells Reservation.	2,150	18	4,300	36.16	50.98	–	Bermudez Road Asphalt,	1.40	33.49	120.63	5,186 95	Reconstruction,	Emerson Street, Border Road, Stoneham.
Mystic Valley Parkway.	1,000	36	4,000	32.61	86.94	–	Bermudez Road Asphalt,	1.69	40.90	160.45	6,418 08	Reconstruction,	South of substation, Winchester.
Nahant Beach Parkway.	1,100	50	6,000	2.86	1.28	–	Tarvia X, . . .	.07	.94	5.08	304 86	Patching, .	Washington Street to Traffic Road, Nahant.
Nantasket Beach Reservation.	3,760	40	16,711	6.37	9.97	–	Tarvia "B", . .	.24	3.71	20.05	3,350 32	Resurfacing, .	Nantasket Avenue, Hull.
Revere Beach Parkway.	1,640	26	4,738	38.55	74.64	–	Tarvia X, . . .	2.17	30.38	143.57	6,802 44	Reconstruction,	Vine Street to Everett Avenue, southerly road, Everett.
Revere Beach Reservation.	6,000	40	26,667	1.24	3.45	–	Tarine No. 2, . .	.33	4.66	9.35	2,494 14	Surface treatment.	Oak Island Avenue to Northern Circle, Revere.
Stony Brook Reservation.	4,600	16[1]	4,088	2.28	–	–	Asphaltic Oil No. 6, .	.59	9.69	11.97	489 18	Surface treatment.	Turtle Pond Road, Boston.
Stony Brook Reservation.	4,100	16	7,288	.86	–	–	Asphaltic Oil No. 6, .	.22	3.61	4.47	326 12	Surface treatment.	Border Road, Boston.
Stony Brook Reservation.	2,100	16[1]	1,866	1.67	–	–	Asphaltic Oil No. 6, .	.43	7.60	9.27	173 06	Surface treatment.	Bold Knob Road, Boston.
Winthrop Shore Reservation.	3,971	36	15,884	1.44	1.07	–	Tarvia X, . . .	.04	.56	3.07	487 14	Patching, .	Winthrop Shore Drive, Winthrop.

[1] Full width of road not treated.

FINANCIAL STATEMENT, PARKS DIVISION.

Loan Appropriations.

The appropriations heretofore made in the form of loans, with accretions thereto, are as follows: —

Metropolitan Parks Loan Fund.

Original appropriation, chapter 407, Acts of 1893,	$1,000,000 00
General appropriation, chapter 483, Acts of 1894,	500,000 00
Charles River Act, chapter 509, Acts of 1894,	300,000 00
General appropriation, chapter 305, Acts of 1895,	500,000 00
General appropriation, chapter 466, Acts of 1896,	1,000,000 00
General appropriation, chapter 464, Acts of 1897,	500,000 00
General appropriation, chapter 530, Acts of 1898,	1,000,000 00
Revere Beach Bath-house Act, chapter 142, Acts of 1899,	125,000 00
General appropriation, chapter 406, Acts of 1899,	300,000 00
Charles River Improvement Act, chapter 465, Acts of 1900,	50,000 00
Fuller's Wharf Act, chapter 467, Acts of 1900,	30,000 00
General appropriation, chapter 445, Acts of 1901,	450,000 00
Mystic River Bridge Act, chapter 492, Acts of 1901,	200,000 00
General appropriation, chapter 290, Acts of 1903,	125,000 00
Newton Upper Falls Bridge Act, chapter 391, Acts of 1903,	40,000 00
Continuing appropriation, chapter 429, Acts of 1903,	1,500,000 00
Nahant Beach Bath-house Act, chapter 326, Acts of 1904,	70,000 00
Reimbursing loan for moth expense, chapter 486, Acts of 1906,	50,000 00
Purification of Mystic River, Alewife Brook and adjacent water-courses, ponds and drainage areas, chapter 529, Acts of 1906,	100,000 00
Additional appropriation for purification of Mystic River, etc., chapter 529, Acts of 1907,	25,000 00
Mystic River and Winthrop Shore Act, chapter 652, Acts of 1908,	70,000 00
Charles River Land Act, chapter 628, Acts of 1910, and chapter 439, Acts of 1911,	143,043 96
Alewife Brook Purification Act, chapter 458, Acts of 1911,	15,000 00
Work for unemployed, chapter 4, General Acts of 1915,	50,000 00
Weston Bridge Act, chapter 368, Special Acts of 1915,	50,000 00
	$8,193,043 96

To provide for interest and sinking fund requirements to 1900, chapter 311, Acts of 1897,	$900,000 00
Total amount of loans,	$9,093,043 96
Amounts received from sales of buildings, receipts from bath-houses, fines, etc.,	198,942 81
Total,	$9,291,986 77

METROPOLITAN PARKS LOAN FUND, SERIES II.

Original boulevard, chapter 288, Acts of 1894,	$500,000 00
General appropriation, chapter 472, Acts of 1896,	500,000 00
General appropriation, chapter 521, Acts of 1897,	1,000,000 00
Saugus Bridge Act, chapter 547, Acts of 1898,	100,000 00
General appropriation, chapter 428, Acts of 1899,	500,000 00
Mattapan Bridge Act, chapter 443, Acts of 1900,	75,000 00
Winchester Act, chapter 444, Acts of 1900,	50,000 00
Revere Beach Parkway Act, chapter 445, Acts of 1900,	200,000 00
General appropriation, chapter 172, Acts of 1902,	450,000 00
General appropriation, chapter 359, Acts of 1903,	110,000 00
Continuing appropriation, chapter 419, Acts of 1903,	1,500,000 00
Alewife Brook and Fresh Pond Parkway Act, chapter 651, Acts of 1908,	50,000 00
Continuing appropriation, chapter 699, Acts of 1912,	1,000,000 00
Wellington Bridge Act, chapter 794, Acts of 1914,	115,000 00
Work for unemployed, chapter 5, Special Acts of 1915,	50,000 00
Alewife Brook Parkway construction, chapter 243, General Acts of 1915,	35,000 00
Neponset Bridge Act, chapter 300, General Acts of 1915,	350,000 00
Wellington Bridge Act, chapter 178, General Acts of 1916,	11,000 00
Improvement of lands in Arlington, chapter 186, General Acts of 1916,	20,000 00
Parkway connecting Blue Hills Reservation and Granite Street, Braintree, chapter 235, General Acts of 1916,	10,000 00
Construction of Dedham Parkway, chapter 237, General Acts of 1916,	10,000 00
Additional appropriation for Neponset Bridge construction, chapter 220, General Acts of 1917,	100,000 00
Settlement of claims for land, Furnace Brook Parkway, chapter 316, General Acts of 1917,	8,000 00
Completion of boulevards and roadways, chapter 175, General Acts of 1919,	250,000 00
Additional appropriation for Neponset Bridge construction, chapter 238, General Acts of 1919,	170,000 00
	$7,164,000 00

To provide for interest and sinking fund requirements to 1900, chapter 311, Acts of 1917,	$100,000 00
Total amount of loans,	$7,264,000 00
Receipts from sales, etc.,	36,123 82
Total,	$7,300,123 82

NANTASKET BEACH LOAN.

Appropriation, chapter 464, Acts of 1899,	$600,000 00
Appropriation, chapter 456, Acts of 1901,	100,000 00
Total amount of loans,	$700,000 00
Receipts from rents, etc.,	5,881 50
Total,	$705,881 50

CHARLES RIVER BASIN LOAN.

Bonds issued for 1904,	$250,000 00
Bonds issued for 1905,	400,000 00
Bonds issued for 1906,	600,000 00
Bonds issued for 1907,	1,150,000 00
Bonds issued for 1908,	400,000 00
Bonds issued for 1909,	850,000 00
Bonds issued for 1910,	475,000 00
Bonds issued for 1911,	300,000 00
Appropriation, chapter 539, Acts of 1913,	40,000 00
Driveway, Brooks Street to Charlesbank Road, chapter 188, General Acts of 1915,	35,000 00
Total amount of bonds,	$4,500,000 00
Receipts added to loan,	9,368 91
Total,	$4,509,368 91

EXPENDITURES FROM LOANS.

The following tables show the total amount expended in each of the foregoing loans, the total cost of each reservation and parkway to Dec. 1, 1920, and the amount charged by the Auditor's department to meet the sinking fund and interest requirements previous to Jan. 1, 1900. The item of "Miscellaneous" in these tables includes cost of construction of roads, buildings and of all other work of construction, and all other charges against these loans except

those for land, general expenses, sinking fund and cost of maintenance required by law to be charged to loans up to 1897. The total charges for maintenance to 1897, general expenses and sinking fund are given separately at the end of the tables. The amounts expended from these loans for the fiscal year ending Nov. 30, 1920, are stated in tables on pages 63 to 65. The total amounts charged to those loans are as follows: —

Metropolitan Parks Loan Fund.

Land,	$5,393,648 66
Miscellaneous, including construction of roads, buildings, etc.,	3,395,281 79
General expense,	163,371 12
Maintenance to Jan. 1, 1897, sinking fund assessments to Jan. 1, 1900, and interest,	290,326 56
Transfer to Serial Bond Loan,	3,601 10
	$9,246,229 23

Metropolitan Parks Loan Fund, Series II.

Land,	$2,287,750 49
Miscellaneous, including construction of roads, buildings, etc.,	4,178,949 96
General expense,	107,090 19
Sinking fund assessments to Jan. 1, 1900, and one-half interest,	59,195 89
	$6,632,986 53

Nantasket Beach Loan.

Land,	$603,329 57
Miscellaneous, including construction of buildings, etc.,	102,551 93
	$705,881 50

Expenditures to Dec. 1, 1920.

Metropolitan Parks Loan Fund.

Blue Hills Reservation: —		
Land,	$363,357 29	
Miscellaneous,	307,058 66	
		$670,415 95
Middlesex Fells Reservation: —		
Land,	$691,162 69	
Miscellaneous,	294,557 47	
		985,720 16

Revere Beach Reservation: —		
Land,	$1,162,947 67	
Miscellaneous,	800,999 04	
		$1,963,946 71
Stony Brook Reservation: —		
Land,	$281,243 87	
Miscellaneous,	76,810 67	
		358,054 54
Beaver Brook Reservation: —		
Land,	$29,819 29	
Miscellaneous,	24,437 35	
		54,256 64
Hemlock Gorge Reservation: —		
Land,	$53,254 00	
Miscellaneous,	15,543 94	
		68,797 94
Charles River Reservation: —		
Land,	$1,569,391 51	
Miscellaneous,	340,921 43	
		1,910,312 94
Neponset River Reservation: —		
Land,	$233,473 04	
Miscellaneous,	46,418 97	
		279,892 01
Mystic River Reservation: —		
Land,	$243,733 21	
Miscellaneous,	380,815 51	
		624,548 72
Lynn Shore Reservation: —		
Land,	$361,199 29	
Miscellaneous,	243,580 01	
		604,779 30
Quincy Shore Reservation: —		
Land,	$73,726 26	
Miscellaneous,	198,160 63	
		271,886 89
Winthrop Shore Reservation: —		
Land,	$51,067 32	
Miscellaneous,	170,560 99	
		221,628 31

Hart's Hill Reservation: —		
Land,	$10,000 00	
Miscellaneous,	202 35	
		$10,202 35
King's Beach Reservation: —		
Land,	$24,297 21	
Miscellaneous,	1,551 63	
		25,848 84
West Roxbury Parkway: —		
Land,	$244,976 01	
Miscellaneous,	8,313 67	
		253,289 68
Wellington Bridge: —		
Miscellaneous,	$185,317 42	
		185,317 42
Nahant Beach Bath-house: —		
Miscellaneous,	$67,794 58	
		67,794 58
Boylston Street Bridge: —		
Miscellaneous,	$45,838 57	
		45,838 57
Alewife Brook Purification: —		
Miscellaneous,	$136,398 90	
		136,398 90
Weston Bridge: —		
Miscellaneous,	$50,000 00	
		50,000 00
General expense,		163,371 12
		$8,952,301 57
Sinking fund requirements to 1896,	$18,980 18	
Care and maintenance to July 1, 1896,	85,813 46	
Care and maintenance, July 1, 1896, to Jan. 1, 1897,	19,604 06	
Sinking fund assessment for 1897,	63,630 70	
Sinking fund assessment for 1898,	9,755 55	
Sinking fund assessment for 1899,	64,224 00	
Interest,	28,318 61	
Transfer to Serial Bond Loan (unexpended balance Alewife Brook purification appropriation),	3,601 10	
		293,927 66
Total charged to Dec. 1, 1920,		$9,246,229 23
Balance Dec. 1, 1920,		45,757 54
		$9,291,986 77

METROPOLITAN PARKS LOAN FUND, SERIES II.

Blue Hills Parkway: —		
Land,	$133,505 02	
Miscellaneous,	269,513 47	
		$403,018 49
Middlesex Fells Parkway: —		
Land,	$263,687 60	
Miscellaneous,	613,667 39	
		877,354 99
Mystic Valley Parkway: —		
Land,	$203,990 91	
Miscellaneous,	425,422 56	
		629,413 47
Revere Beach Parkway: —		
Land,	$537,445 51	
Miscellaneous,	869,565 65	
		1,407,011 16
Neponset River Parkway: —		
Land,	$83,941 75	
Miscellaneous,	36,100 54	
		120,042 29
Fresh Pond Parkway: —		
Land,	$44,086 25	
Miscellaneous,	31,635 58	
		75,721 83
Furnace Brook Parkway: —		
Land,	$173,897 77	
Miscellaneous,	271,760 64	
		445,658 41
Nahant Beach Parkway: —		
Land,	$80,940 78	
Miscellaneous,	76,260 11	
		157,200 89
Lynn Fells Parkway: —		
Land,	$40,468 46	
Miscellaneous,	126,373 84	
		166,842 30
Winthrop Parkway: —		
Land,	$133,390 73	
Miscellaneous,	90,011 11	
		223,401 84
Alewife Brook Parkway: —		
Land,	$144,497 74	
Miscellaneous,	45,705 13	
		190,202 87

Charles River Speedway: —		
Miscellaneous,	$521,348 66	
		$521,348 66
Blue Hills roads: —		
Miscellaneous,	$8,742 06	
		8,742 06
Middlesex Fells roads: —		
Miscellaneous,	$79,431 67	
		79,431 67
Stony Brook roads: —		
Miscellaneous,	$37,183 45	
		37,183 45
Lynnway: —		
Land,	$20,500 00	
Miscellaneous,	124,368 29	
		144,868 29
Spy Pond Parkway: —		
Miscellaneous,	$89 04	
		89 04
Old Colony Parkway: —		
Land,	$299,821 36	
Miscellaneous,	82,266 28	
		382,087 64
Woburn Parkway: —		
Land,	$3,958 75	
Miscellaneous,	52,038 32	
		55,997 07
Dedham Parkway: —		
Land,	$22,027 01	
Miscellaneous,	30,968 24	
		52,995 25
Hammond Pond Parkway: —		
Land,	$94,965 85	
Miscellaneous,	5,061 45	
		100,027 30
Quannapowitt Parkway: —		
Land,	$6,625 00	
Miscellaneous,	1,831 82	
		8,456 82
West Roxbury Parkway: —		
Miscellaneous,	$49,639 93	
		49,639 93

Vose's Grove: —		
Miscellaneous,	$980 08	
		$980 08
Wellington Bridge: —		
Miscellaneous,	$120,796 40	
		120,796 40
Neponset Bridge: —		
Miscellaneous,	$163,468 20	
		163,468 20
Arlington Parkway: —		
Miscellaneous,	$4,035 12	
		4,035 12
Nonantum Road: —		
Miscellaneous,	$39,295 08	
		39,295 08
West Street, Braintree: —		
Miscellaneous,	$1,389 85	
		1,389 85
General expense,		107,090 19
		$6,573,790 64
Sinking fund requirements for 1896,	$3,650 03	
Sinking fund requirements for 1897,	14,057 10	
Sinking fund requirements for 1898,	3,765 08	
Sinking fund requirements for 1899,	15,396 00	
One-half interest,	22,327 68	
		59,195 89
Total charged to Dec. 1, 1920,		$6,632,986 53
Balance Dec. 1, 1920,		667,137 29
		$7,300,123 82

NANTASKET BEACH LOAN.

Land,	$603,329 57
Miscellaneous,	102,551 93
Total charged to Dec. 1, 1920,	$705,881 50

CHARLES RIVER BASIN LOAN.

Expended from beginning of work to Dec. 1, 1920,		$4,472,747 22

The above amount has been distributed as follows: —

Administration,	$108,110 16	
Dam,	1,118,772 60	
Lock,	724,142 64	
Temporary bridge and approaches,	184,895 36	
Drawbridge,	100,371 06	
Highway,	55,557 85	
Dredging, pile-driving and protection work in Basin,	179,881 35	
Broad Canal,	117,251 64	
Lechmere Canal,	53,388 87	
Boston Embankment,	895,213 92	
Boston Marginal Conduit,	635,511 96	
Cambridge Marginal Conduit,	99,472 48	
Elimination of malarial mosquitoes,	1,173 68	
Landing piers,	7,667 99	
Float anchorage,	23 90	
Police signal system,	9,847 56	
Improvement of south bank and driveway,	31,506 09	
Service sheds,	19,198 95	
Mortuary,	1,560 66	
Otter Street widening,	34,762 82	
Landing near Faneuil Station,	1,057 83	
Alterations and improvements in stable and stable yard,	2,052 15	
Shelters,	2,615 19	
Rent of land,	2 00	
Maintenance,	88,708 51	
		$4,472,747 22

METROPOLITAN PARKS TRUST FUND.

Receipts,	$40,287 33	
Expenditures,	38,106 50	
Balance Dec. 1, 1920,		$2,180 83

Detailed Statement.

Expenditures Dec. 1, 1919, to Dec. 1, 1920.

Metropolitan Parks Loan Fund.

Metropolitan Parks Loan Fund,			$9,093,043 96
Receipts added to loan before June 1, 1901,			198,942 81
			$9,291,986 77
Expenditures.			
Charles River Reservation: —			
Legal,	$200 00		
Claims,	250 00		
		$450 00	
Mystic River Reservation: —			
Land,		850 00	
			$1,300 00
Amounts charged to Dec. 1, 1919,			9,244,929 23
			9,246,229 23
Balance,			$45,757 54

Metropolitan Parks Loan Fund, Series II.

Metropolitan Parks Loan Fund, Series II,			$7,264,000 00
Receipts from sales, etc.,			36,123 82
			$7,300,123 82
Expenditures.			
Furnace Brook Parkway: —			
Construction: —			
Contract, Coleman Brothers,	$25,409 63		
Labor and materials,	2,593 00		
		$28,002 63	
Engineering: —			
Services,	$2,519 12		
Expenses,	453 44		
		2,972 56	
			$30,975 19
Nahant Beach Parkway: —			
Labor and materials,			245 98
Winthrop Parkway: —			
Land,		$475 00	
Construction: —			
Contract, Coleman Brothers,	$15,867 68		
Labor and materials,	1,127 68		
		16,995 36	
Engineering: —			
Services,	$1,085 93		
Expenses,	99 44		
		1,185 37	
			18,655 73
Middlesex Fells Roads: —			
Construction: —			
Labor and materials,		$14,493 14	
Legal,		75 00	
			14,568 14
Amounts carried forward,			$64,445 04 $7,300,123 82

Amounts brought forward,			$64,445 04	$7,300,123 82
Old Colony Parkway: —				
Land,		$2,872 10		
Filling material,		9,951 23		
Labor,		262 18		
Engineering: —				
Services,	$626 90			
Expenses,	20 45			
		647 35		
Legal,		400 00		
Advertising,		9 00		
			14,141 86	
Dedham Parkway: —				
Land,		$11,500 00		
Construction: —				
Contract, Powers Company,	$2,826 25			
Labor and materials,	4,616 60			
		7,442 85		
Engineering: —				
Services,	$650 32			
Expenses,	152 60			
		802 92		
Legal,		30 00		
			19,775 77	
West Roxbury Parkway: —				
Construction: —				
Contract, Rowe Contracting Company,	$35,529 24			
Labor and materials,	5,577 86			
		$41,107 10		
Engineering: —				
Services,	$3,548 80			
Expenses,	199 10			
		3,747 90		
			44,855 00	
Neponset Bridge: —				
Construction: —				
Labor and materials,		$6,713 33		
Engineering: —				
Services,	$3,046 02			
Expenses,	680 03			
		3,726 05		
Consulting engineers,		2,419 25		
Rental of land,		500 00		
			13,358 63	
Nonantum Road: —				
Construction: —				
Contract, A. G. Tomasello,	$33,835 88			
Labor and materials,	2,996 88			
		$36,832 76		
Engineering: —				
Services,	$1,221 20			
Expenses,	48 71			
		1,269 91	38,102 67	
			$194,678 97	
Amounts charged to Dec. 1, 1919,			6,438,307 56	
				6,632,986 53
Balance,				$667,137 29

North Beacon Street Bridge Loan.

Chapter 780, Acts of 1914,	$175,000 00
Amounts charged to Dec. 1, 1919,	174,853 50
Balance,	$146 50

Charles River Basin Loan.

Total amount of loan,	$4,500,000 00
Receipts added to loan,	9,368 91
Total,	$4,509,368 91
Amounts charged to Dec. 1, 1919,	4,472,747 22
Balance,	$36,621 69

Metropolitan Parks System Maintenance.

Appropriation Dec. 1, 1919, to Dec. 1, 1920, $705,477 39

Expenditures.

General expense: —			
Police: —			
Pay rolls,	$163,154 13		
Miscellaneous,	20,374 71		
		$183,528 84	
Salaries: —			
Commissioners,	$2,500 00		
General office,	10,054 84		
Engineering department,	12,249 61		
		24,804 45	
Rent, lighting and care of offices,		3,980 02	
Engineering: —			
Office supplies,	$1,018 18		
Automobile expense,	555 96		
		1,574 14	
Office supplies,		1,659 56	
Stationery and printing,		833 58	
Telephones,		441 84	
Maps and books,		104 21	
Traveling,		36 66	
			$216,963 30
Blue Hills Reservation: —			
General labor,		$48,944 59	
Gypsy and brown-tail moth work: —			
Labor,	$37,203 36		
Supplies,	10,622 50		
		47,825 86	
Road repairs: —			
Labor,	$301 11		
Supplies,	2,286 25		
		2,587 36	
Horses, carriages, automobiles, etc.,		9,721 89	
Keep of horses,		7,106 79	
General supplies,		5,312 47	
Telephones,		368 21	
Express and freight,		351 47	
Architects' services,		200 00	
Water rates,		178 47	
Amounts carried forward,		$122,597 11	$216,963 30 $705,477 39

Amounts brought forward,		$122,597 11	$216,963 30	$705,477 39
Lighting buildings,		168 59		
Stationery and printing,		120 77		
Physicians' services, etc.,		113 55		
Repairs,		55 65		
Postage,		37 50		
Demurrage,		6 00		
			123,099 17	
Middlesex Fells Reservation: —				
General labor,		$32,854 46		
Gypsy and brown-tail moth work: —				
Labor,	$25,860 28			
Supplies,	3,201 09			
		29,061 37		
Road repairs: —				
Labor,		8,392 53		
General supplies,		4,290 40		
Horses, carriages, automobiles, etc.,		2,851 13		
Keep of horses,		2,740 54		
Repairs,		489 16		
Lighting buildings,		427 00		
Telephones,		374 55		
Stationery and printing,		204 30		
Water rates,		54 90		
Rent,		45 00		
Express and freight,		39 31		
Postage,		34 00		
Physicians' services,		33 50		
Traveling,		9 23		
			81,901 38	
Revere Beach Reservation: —				
General labor,		$37,341 63		
Road repairs: —				
Labor,	$1,062 54			
Supplies,	2,315 57			
		3,378 11		
General supplies,		5,985 33		
Street lighting,		5,144 54		
Horses, carriages, automobiles, etc.,		3,486 86		
Keep of horses,		1,789 44		
Lighting buildings,		628 79		
Telephones,		488 96		
Water rates,		255 77		
Stationery and printing,		132 57		
Repairs,		112 87		
Postage,		41 17		
Express,		20 71		
			58,806 75	
Stony Brook Reservation: —				
General labor,		$3,861 00		
Gypsy and brown-tail moth work: —				
Labor,	$2,530 90			
Supplies,	3,104 08			
		5,634 98		
Road repairs: —				
Labor,	$250 09			
Supplies,	240 00			
		490 09		
Amounts carried forward,		$9,986 07	$480,770 60	$705,477 39

Amounts brought forward,			$9,986 07	$480,770 60	$705,477 39
Horses, carriages, automobiles, etc.,			2,750 00		
Keep of horses,			105 50		
Telephones,			43 30		
Repairs,			11 90		
				12,896 77	
Beaver Brook Reservation: —					
General labor,			$1,834 19		
Gypsy and brown-tail moth work: —					
Labor,	$902 63				
Supplies,	172 70				
			1,075 33		
General supplies,			621 44		
Telephones,			52 95		
Water rates,			50 70		
Stationery and printing,			29 26		
Lighting buildings,			12 40		
Express and freight,			1 88		
Traveling,			1 50		
				3,679 65	
Charles River Upper Division: —					
General labor,			$28,675 01		
Gypsy and brown-tail moth work: —					
Labor,	$7,728 23				
Supplies,	2,925 60				
			10,653 83		
Road repairs: —					
Labor,	$1,580 95				
Supplies,	5,288 97				
			6,869 92		
General supplies,			12,826 52		
Horses, carriages, automobiles, etc.,			6,909 35		
Keep of horses,			3,149 94		
Lighting,			1,160 35		
Police boats,			638 28		
Telephones,			455 89		
Lighting buildings,			389 46		
Stationery and printing,			233 28		
Use of snowplow,			210 45		
Water rates,			191 16		
Cork buoys,			129 36		
200-gallon tank,			60 00		
Physicians' services, etc.,			53 00		
Traveling,			32 92		
Express and freight,			30 68		
Postage,			24 50		
Repairs,			18 30		
				72,712 20	
Riverside Recreation Grounds: —					
General labor,			$3,706 94		
General supplies,			2,889 95		
Lighting buildings,			192 63		
Rental of sewer,			162 90		
Telephones,			103 83		
Water rates,			54 20		
Electric power,			51 92		
Horses, carriages, automobiles, etc.,			27 37		
Repairs,			21 22		
Physicians' services, etc.,			17 00		
Amounts carried forward,			$7,227 96	$570,059 22	$705,477 39

Amounts brought forward,			$7,227 96	$570,059 22	$705,477 39
Express and freight,			10 55		
Keep of horses,			2 38		
Postage,			1 00		
				7,241 89	
Neponset River Reservation: —					
General labor,			$98 90		
Gypsy and brown-tail moth work: —					
Labor,	$455 84				
Supplies,	900 00				
		1,355 84			
Telephones,			68 87		
				1,523 61	
Mystic River Reservation. —					
General labor,			$15,740 45		
General supplies,			1,259 87		
Electric power,			375 00		
Horses, carriages, automobiles, etc.,			208 76		
Repairs,			106 70		
Street lighting,			93 61		
Telephones,			53 94		
Water rates,			6 60		
Keep of horses,			5 00		
Postage,			3 50		
Traveling,			2 24		
				17,855 67	
Lynn Shore Reservation: —					
General labor,			$8,745 27		
Road repairs: —					
Labor,	$720 11				
Supplies,	2,062 27				
		2,782 38			
General supplies,			3,007 83		
Street lighting,			2,520 00		
Automobile expense,			236 39		
Water rates,			17 60		
				17,309 47	
Quincy Shore Reservation: —					
General labor,			$9,177 93		
Gypsy and brown-tail moth work: —					
Supplies,			2,753 18		
Road repairs: —					
Labor,			2,209 08		
Street lighting,			2,374 93		
General supplies,			1,525 45		
Auto expense,			887 25		
Telephones,			59 61		
Water rates,			45 84		
Lighting buildings,			19 68		
Repairs,			11 60		
				19,064 55	
Winthrop Shore Reservation: —					
General labor,			$8,124 08		
Road repairs: —					
Labor,	$228 85				
Supplies,	258 29				
		487 14			
General supplies,			2,302 02		
Street lighting,			615 96		
Repairs,			110 01		
Water rates,			9 50		
				11,648 71	
Amounts carried forward,				$644,703 12	$705,477 39

Amounts brought forward,		$644,703 12	$705,477 39
Pensions: —			
Chamberlin pension,	$929 13		
Elder pension,	844 67		
Barry pension,	736 19		
Armstrong pension,	669 26		
Kenney pension,	669 26		
Lord pension,	669 26		
Haddock pension,	640 50		
Finn pension (Annie L. Finn),	600 00		
Harding pension,	600 00		
Stewart pension,	600 00		
Finn pension (Benjamin Finn),	594 77		
Powers pension,	400 00		
Woodworth allowance,	364 00		
Cadegan pension,	352 60		
Mateer pension,	300 00		
McCarthy pension,	165 32		
Ellis pension,	164 52		
Donohoe pension,	64 11		
Philbrick pension,	64 11		
White pension,	59 18		
		9,486 88	
			654,190 00
Balance,			$51,287 39

Special Appropriations.

Band Concerts.

Appropriation,			$35,000 00
Expenditures.			
Blue Hills Division: —			
Bands,	$1,509 00		
Construction of band stands,	86 37		
Extra police,	5 00		
		$1,600 37	
Middlesex Fells Division: —			
Bands,	$3,084 76		
Extra police,	1 00		
		3,085 76	
Revere Beach Division: —			
Bands,	$4,130 00		
Band stands,	369 74		
Labor,	115 20		
		4,614 94	
Charles River Upper Division: —			
Bands,	$2,603 50		
Extra police,	5 50		
		2,609 00	
Nahant Beach Parkway: —			
Bands,	$1,410 00		
Labor,	28 80		
		1,438 80	
Nantasket Beach Reservation: —			
Bands,		6,652 00	
Bunker Hill Monument: —			
Bands,	$165 00		
Extra police,	50		
		165 50	
			20,166 37
Balance,			$14,833 63

System Maintenance.

Chapter 629, Acts of 1920.

Appropriation,	$5,000 00
Expenditure: —	
Dredging Aberjona River: —	
Contract, Coleman Brothers,	4,918 26
Balance,	$81 74

Metropolitan Parks, Boulevard Maintenance.

Appropriation Dec. 1, 1919, to Dec. 1, 1920, ... $433,355 00

Expenditures.

General Expense: —			
Police: —			
Pay rolls,	$68,530 16		
Miscellaneous,	13,787 81		
		$82,317 97	
Salaries: —			
Commissioners,	$2,500 00		
General office,	10,423 79		
Engineering department,	12,196 25		
		25,120 04	
Rent, lighting and care of offices,		5,125 54	
Engineering: —			
Automobile expense,	$1,124 71		
Office supplies,	719 89		
		1,844 60	
Office supplies,		1,009 99	
Stationery and printing,		877 09	
Telephones,		534 67	
Maps and books,		93 48	
			$116,923 38
Blue Hills Parkway: —			
General labor,		$8,666 31	
Gypsy and brown-tail moth work: —			
Labor,		533 11	
Road repairs: —			
Labor,	$1,702 89		
Supplies,	3,750 50		
		5,453 39	
Street lighting,		2,351 23	
General supplies,		482 26	
Horses, carriages, automobiles, etc.,		103 21	
Water rates,		31 07	
Physicians, etc.,		28 00	
Repairs,		25 00	
Lighting buildings,		9 51	
			17,683 09
Middlesex Fells Parkway: —			
General labor,		$21,936 61	
Gypsy and brown-tail moth work: —			
Labor,		963 69	
Road repairs: —			
Labor,	$5,072 89		
Supplies,	4,295 63		
		9,368 52	
Amounts carried forward,		$32,268 82	$134,606 47 $433,355 00

Amounts brought forward,			$32,268 82	$134,606 47	$433,355 00
Street lighting,			13,423 90		
General supplies,			4,662 17		
Horses, carriages, automobiles, etc.,			784 59		
Advertising,			209 55		
Telephones,			101 45		
Physicians, etc.,			82 00		
Repairs,			40 75		
Services of flagman, repairs to bridge,			38 88		
Water rates,			16 40		
Lighting buildings,			10 50		
				51,639 01	
Mystic Valley Parkway: —					
General labor,			$18,494 06		
Gypsy and brown-tail moth work: —					
Labor,			1,802 07		
Road repairs: —					
Labor,		$6,172 05			
Supplies,		6,265 46			
			12,437 51		
Street lighting,			4,352 75		
General supplies,			2,320 70		
Horses, carriages, automobiles, etc.,			1,098 57		
Telephones,			83 05		
Water rates,			25 12		
Physicians, etc.,			15 00		
Stationery and printing,			6 65		
				40,635 48	
Revere Beach Parkway: —					
General labor,			$36,657 69		
Gypsy and brown-tail moth work: —					
Labor,		$487 48			
Supplies,		1 47			
			488 95		
Road repairs: —					
Labor,		$2,607 72			
Supplies,		5,758 31			
			8,366 03		
Street lighting,			10,057 18		
General supplies,			7,227 45		
Horses, carriages, automobiles, etc.,			1,423 34		
Repairs,			739 98		
Power for draw,			367 50		
Water rates,			5 00		
Postage,			4 00		
				65,337 12	
Neponset River Parkway: —					
General labor,			$1,171 33		
Gypsy and brown-tail moth work: —					
Labor,			200 68		
General supplies,			49 62		
Automobile expense,			20 01		
				1,441 64	
Nahant Beach Parkway: —					
General labor,			$7,401 33		
Road repairs: —					
Labor,		$171 17			
Supplies,		133 51			
			304 68		
Amounts carried forward,			$7,706 01	$193,659 72	$433,355 00

Amounts brought forward,			$7,706 01	$193,659 72	$433,355 00
Street lighting,			980 00		
Keep of horses,			520 03		
General supplies,			465 76		
Horses, carriages, automobiles, etc.,			139 83		
				9,811 63	
Fresh Pond Parkway: —					
General labor,			$1,428 24		
Gypsy and brown-tail moth work: —					
Labor,	$364 27				
Supplies,	153 66				
		517 93			
Road repairs: —					
Labor,	$195 35				
Supplies,	509 62				
		704 97			
Street lighting,			420 00		
Automobile expense,			163 63		
General supplies,			91 48		
Use of snowplow,			15 00		
				3,341 25	
Furnace Brook Parkway: —					
General labor,			$7,842 58		
Gypsy and brown-tail moth work: —					
Labor,			344 39		
Road repairs: —					
Labor,	$892 80				
Supplies,	1,030 26				
		1,923 06			
Street lighting,			2,575 34		
General supplies,			1,837 62		
Horses, carriages, automobiles, etc.,			182 91		
Water rates,			14 00		
Repairs,			11 55		
Lighting buildings,			5 11		
				14,736 56	
Winthrop Parkway: —					
General labor,			$581 29		
Road repairs: —					
Labor,			26 80		
Street lighting,			235 85		
General supplies,			79 75		
				923 69	
Lynnway: —					
General labor,			$11,208 19		
Road repairs: —					
Labor,	$49 36				
Supplies,	33 27				
		82 63			
General supplies,			1,873 37		
Repairs,			521 46		
Power for lighting and operating draw,			478 99		
Street lighting,			210 00		
Keep of horses,			5 00		
Postage,			4 00		
				14,383 64	
Amounts carried forward,				$236,856 49	$433,355 00

Amounts brought forward,			$236,856 49	$433,355 00
Lynn Fells Parkway: —				
General labor,		$3,286 00		
Road repairs: —				
Labor,	$220 75			
Supplies,	88 40			
		309 15		
Street lighting,		1,554 06		
General supplies,		490 11		
Automobile expense,		133 85		
			5,773 17	
Middlesex Fells Roads: —				
General labor,		$4,123 03		
Road repairs: —				
Labor,	$7,024 33			
Supplies,	8,431 01			
		15,455 34		
Street lighting,		2,595 74		
Automobile expense,		184 53		
General supplies,		78 19		
			22,436 83	
Alewife Brook Parkway: —				
General labor,		$10,827 10		
Gypsy and brown-tail moth work: —				
Labor,		188 12		
Road repairs: —				
Labor,	$673 84			
Supplies,	99 60			
		773 44		
General supplies,		1,714 52		
Horses, carriages, automobiles, etc.,		905 07		
Street lighting,		896 48		
Physicians' services, etc.,		56 75		
			15,361 48	
Woburn Parkway: —				
General labor,		$3,949 82		
Gypsy and brown-tail moth work: —				
Labor,		56 81		
Road repairs: —				
Supplies,		45 00		
Horses, carriages, automobiles, etc.,		838 88		
General supplies,		308 25		
Street lighting,		175 49		
Water rates,		15 86		
			5,390 11	
Hammond Pond Parkway: —				
General labor,			1,535 18	
Neponset River Bridge: —				
General labor,		$11,134 77		
General supplies,		1,342 74		
Street lighting,		150 00		
Telephones,		34 26		
Postage,		2 00		
			12,663 77	
				400,017 03
Balance,				$33,337 97

Boulevard Maintenance.

Special Items, Chapter 629, Acts of 1920.

Appropriation,			$95,000 00
Expenditures.			
Middlesex Fells Parkway: —			
Construction: —			
Contract, Simpson Brothers,	$14,937 41		
Labor and materials,	147 85		
		$15,085 26	
Engineering: —			
Services,	$534 08		
Expenses,	27 00		
		561 08	
Advertising,		49 95	
			$15,696 29
West Roxbury Parkway: —			
Engineering: —			
Services,		$583 64	
Expenses,		89 94	
			673 58
			16,369 87
Balance,			$78,630 13

Charles River Basin Maintenance.

Maintenance of Parks and Water Areas.

Appropriation,			$119,231 44
Expenditures.			
General labor,		$35,408 49	
Teaming,		878 00	
			$36,286 49
Police: —			
Pay rolls,		$49,672 70	
Miscellaneous,		5,392 33	
			55,065 03
Street lighting,			4,745 49
General supplies,			3,920 84
Horses, carriages, automobiles, etc.,			2,005 15
Lighting buildings,			1,207 86
Water rates,			733 46
Keep of horses,			308 55
Telephones,			201 42
Stationery and printing,			183 90
Repairs,			43 20
Physicians' services,			20 00
Express,			7 83
Postage,			3 00
			104,732 22
Balance,			$14,499 22

Maintenance and Operation of Locks, Gates and Drawbridges.

Appropriation,			$80,500 22
EXPENDITURES.			
General labor,	$43,636 47		
Teaming,	5,460 23		
		$49,096 70	
Ice-breaking: —			
Labor,	$15,254 88		
Supplies,	5,415 76		
		20,670 64	
Coal,		3,524 27	
General supplies,		2,434 27	
Repairs,		1,581 10	
Electric power,		1,563 74	
Heating,		564 35	
Lighting lock-gate houses and sluices,		515 05	
Automobile expense,		231 27	
Telephones,		108 50	
Keep of horses,		43 30	
Physicians' services,		5 00	
Water rates,		4 30	
Traveling,		1 50	
Miscellaneous,		88	
			80,344 87
Balance,			$155 35

NANTASKET BEACH MAINTENANCE.

Appropriation,			$70,683 28
EXPENDITURES.			
General labor,		$22,403 69	
Road repairs: —			
Labor,	$5,602 43		
Supplies,	3,292 15		
		8,894 58	
Police: —			
Pay rolls,	$20,126 65		
Miscellaneous,	4,756 10		
		24,882 75	
General supplies,		2,483 83	
Street lighting,		1,920 18	
Coal,		1,404 11	
Horses, carriages, automobiles, etc.,		1,286 64	
Keep of horses,		1,011 82	
Water rates,		681 50	
Rent,		490 00	
Repairs,		480 00	
Telephones,		199 85	
Freight and express,		125 49	
Stationery and printing,		54 81	
Use of snowplow, Nantasket Hotel,		30 00	
Postage,		28 15	
Traveling,		8 52	
			66,385 92
Balance,			$4,297 36

Wellington Bridge Maintenance.

Appropriation,		$16,867 00
Expenditures.		
Labor,	$10,278 13	
Repairs,	2,819 34	
Street lighting,	1,917 04	
General supplies,	289 65	
Telephones,	86 45	
Keep of horses,	5 00	
Postage,	2 00	
		15,397 61
Balance,		$1,469 39

Bunker Hill Monument Maintenance.

Appropriation,			$12,000 00
Expenditures.			
General labor,		$5,535 53	
Police: —			
Pay rolls,	$3,653 86		
Miscellaneous,	142 30		
		3,796 16	
General supplies,		440 87	
Lighting buildings,		425 89	
Telephones,		137 85	
Repairs,		79 40	
Water rates,		12 32	
Keep of horses,		7 50	
Boiler inspection,		2 00	
Stationery and printing,		1 75	
			10,439 27
Balance,			$1,560 73

Bunker Hill — Special Improvement.

Appropriation,				$25,000 00
Expenditures.				
Improvement: —				
Contracts: —				
Jas. H. Fannon,	$13,859 84			
W. L. Waples Company,	5,020 00			
		$18,879 84		
Supplies,		307 83		
			$19,187 67	
Engineering: —				
Services,		$484 53		
Expenses,		35 15		
			519 68	
Advertising,			254 55	
Cleaning and painting fence,			110 00	
Landscape architects: —				
Services,		$41 51		
Expenses,		70		
			42 21	
				20,114 11
Balance,				$4,885 89

Metropolitan Parks Expense Fund.

Receipts, Dec. 1, 1919, to Dec. 1, 1920.

Bath-houses: —			
Revere Beach, sale of bath tickets,	$33,287 50		
Interest,	244 60		
		$33,532 10	
Nantasket Beach, sale of bath tickets,	$20,194 30		
Interest,	42 96		
		20,237 26	
Nahant Beach, sale of bath tickets,		8,645 40	
Blue Hills, sale of bath tickets,		328 70	
			$62,743 46
Rentals: —			
Buildings,		$22,988 02	
Roller-coaster and merry-go-round,		3,500 00	
Lunch stands and refectories,		2,160 00	
Boathouse sites,		1,440 00	
Day rentals, Riverside Recreation Grounds,		1,275 00	
Street railway location,		1,246 48	
Land,		1,227 09	
Houses,		1,081 79	
Ducts,		687 99	
Boats,		620 30	
Automobile stands,		350 00	
Dance hall, Nantasket,		175 00	
Gas main location,		100 00	
			36,851 67
Sales: —			
Wood,		$13,428 27	
Old metal, lumber, paper, etc.,		2,892 58	
Hay and grass,		1,010 55	
Bowling alley,		600 00	
Tower clock,		350 00	
Nursery stock,		185 70	
Sanitary napkins,		180 12	
Old water carts,		160 00	
Posts and stakes,		122 75	
Horse,		100 00	
Gravel,		93 00	
Vegetables,		78 40	
Barrels,		51 05	
Lost articles,		22 99	
Tickets,		9 18	
Plans,		7 42	
Miscellaneous,		2 94	
			19,294 95
Court fines,			7,015 77
Steamer chair and umbrella privilege,			5,350 10
Income on money invested,			4,593 20
Admissions, Bunker Hill Monument,			3,367 30
Sidewalk and entrance construction,			1,131 26
Bags, cans, etc., returned,			800 24
Spraying land in Winchester,			739 07
Repairs to Holmes Memorial,			210 00
Removal of garbage,			210 00
Pay closets,			207 51
Amount carried forward,			$142,514 53

Amount brought forward,		$142,514 53
Souvenir privilege, Bunker Hill Monument,		187 50
Light and water furnished,		182 14
Damage to property,		157 75
Refund on tickets,		104 65
Lost equipment,		96 03
Money found,		51 15
Rebate on lamp contract,		48 34
Newspaper licenses,		45 00
Telephone tolls,		36 51
Conveyance of land,		36 00
Shortage in delivery (coal),		23 47
Replaced keys and checks,		9 00
Rebate on telephone,		8 40
		$143,500 47
Balance Dec. 1, 1919,		152,315 75
		$295,816 22

Expenditures Dec. 1, 1919, to Dec. 1, 1920.

General expense: —			
Advertising privileges,			$60 65
Police: —			
Horses,		$715 00	
Legal services,		250 00	
			965 00
Engineering: —			
Tickets,		$101 13	
Telephone,		9 25	
			110 38
Blue Hills Reservation: —			
Surfacing and grading roads,		$3,500 00	
Portable sawmill rig,		313 00	
Repairs to buildings,		256 08	
Skiff and oars,		246 91	
Bath-house tickets,		2 50	
			4,318 49
Middlesex Fells Reservation: —			
Repairs to buildings,		$926 10	
Flags,		43 20	
Construction of drain,	$7 05		
Refund,	14 62		
		21 67	
			990 97
Revere Beach Reservation: —			
Bath-house: —			
Pay rolls,	$25,191 10		
Bathing suits,	5,115 02		
Coal,	3,216 15		
Towels,	1,117 90		
Lighting,	752 25		
Repairs,	601 87		
Stationery,	371 93		
Stockings,	338 10		
Tickets, etc.,	267 38		
Lumber, etc.,	262 03		
Engine room,	259 15		
Soap, etc.,	247 55		
Water rates,	230 40		
Bathing caps,	179 58		
Time stamps,	165 00		
Amounts carried forward,	$38,315 41		$6,445 49

Amounts brought forward,		$38,315 41	$38,315 41
Hardware,	151 38		
Neck bands,	149 10		
Ice,	128 19		
Uniforms,	65 00		
Sanitary napkins,	64 45		
Paint,	63 36		
Drilling,	60 14		
Medicines and attendance,	50 48		
Telephones,	48 65		
Findings,	46 18		
Electric fan,	31 36		
Watchman's clock parts,	30 91		
Wrapping paper,	27 86		
Claim for damages,	25 00		
Stencils,	19 56		
Rental of typewriter,	18 00		
Electric bell,	12 25		
Photos,	12 00		
Express,	11 67		
Kerosene,	9 40		
Advertising,	7 95		
Rubber banding for mat,	7 67		
Oars,	6 17		
Electric heater,	5 75		
Fuses,	5 11		
Brass checks,	4 97		
Water carboys,	4 50		
Combs,	4 12		
Bicarbonate of soda,	3 27		
Miscellaneous,	8 35		
		$39,398 21	
Storm damage,		788 16	
Ford touring car,		394 00	
Entrance construction,	$128 52		
Refund,	5 15		
		133 67	
Advertising,		45 15	
Rewiring shelters,		35 56	
			40,794 75
Stony Brook Reservation: —			
Water rates,		$23 68	
Repairs,		7 75	
			31 43
Charles River Upper Division: —			
Pump house,		$904 79	
Water rates,		44 20	
Repairs,		25 92	
Advertising,		25 56	
Towels,		23 28	
Flags,		21 60	
			1,045 35
Lynn Shore Reservation: —			
Repairs to sea wall,			956 45
Quincy Shore Reservation: —			
Building addition to substation,		$934 57	
Refund of deposit for entrance construction,		220 00	
Refund of amount paid for chair privilege,		50 00	
Advertising,		17 25	
			1,221 82
Amount carried forward,			$50,495 29

Amount brought forward,			$50,495 29
Winthrop Shore Reservation: —			
Repairs to sea wall,			9,416 53
Charles River Lower Basin: —			
Naval architects' services,		$1,687 50	
Repairs to Holmes Memorial,		210 00	
			1,897 50
Blue Hills Parkway: —			
Repairs to roadway,		$1,072 67	
Refund of deposit for entrance construction,		103 34	
			1,176 01
Middlesex Fells Parkway: —			
Entrance construction,	$287 03		
Refund of deposits,	43 22		
		$330 25	
Telephones,		6 20	
			336 45
Mystic Valley Parkway: —			
Rebuilding floor of bridge over Aberjona River,		$798 27	
Legal services,		25 00	
Entrance construction,		15 50	
			838 77
Revere Beach Parkway: —			
Refund, entrance construction,		$444 13	
Entrance construction,		150 32	
			594 45
Nahant Beach Parkway: —			
Bath-house: —			
Pay rolls,		$6,180 16	
Bathing suits,		2,196 00	
Lumber, etc.,		431 36	
Coal,		347 50	
Stockings,		225 40	
Lighting,		142 17	
Telephones,		81 04	
Tickets, etc.,		74 44	
Time stamps,		55 00	
Baskets,		51 80	
Paint,		34 61	
Ice,		23 80	
Repairs,		22 36	
Engine room,		22 22	
Repairs to clock,		20 87	
Hardware,		20 34	
Uniform,		20 00	
Oil for lanterns,		17 02	
Combs and brushes,		16 00	
Stationery,		14 96	
Bond renewals,		12 00	
Medicines and attendance,		10 71	
Flags,		10 12	
Fuses,		5 13	
Advertising,		2 20	
			10,037 21
Amount carried forward,			$74,792 21

Amount brought forward,			$74,792 21
Winthrop Parkway: —			
Repairing sea wall: —			
Contract, Coleman Brothers,		$11,763 80	
Engineering services,		83 25	
			11,847 05
Lynn Fells Parkway: —			
Entrance construction,		$90 78	
Refund of deposit,		28 82	
			119 60
Alewife Brook Parkway: —			
Land,		$3,131 26	
Legal services,		100 00	
			3,231 26
Old Colony Parkway: —			
Telephones,			45
Woburn Parkway: —			
Entrance construction,		$69 75	
Refund of deposit,		4 75	
			74 50
Bunker Hill Monument: —			
Brass rail,		$135 83	
Advertising,		2 25	
			138 08
Nantasket Beach Reservation: —			
Bath-house: —			
Pay rolls,	$12,178 27		
Bathing suits,	4,252 00		
Coal,	2,265 88		
Towels,	1,274 07		
Water rates,	514 52		
Stationery and printing,	313 61		
Repairs,	275 41		
Stockings,	173 99		
Ice,	168 72		
Engine room,	151 78		
Uniforms,	134 74		
Safe,	110 00		
Time stamps,	110 00		
Hardware,	108 92		
Bathing caps,	107 31		
Repairs to clock,	102 75		
Soap, etc.,	93 25		
Tickets,	86 35		
Proportioning steam charges,	85 00		
Emergency room,	68 39		
Drilling,	56 26		
Neck bands,	49 90		
Telephones,	41 65		
Lumber, etc.,	37 73		
Electric fan,	32 93		
Baskets,	32 01		
Lighting,	29 45		
Paint,	27 52		
Amounts carried forward,	$22,882 41		$90,203 15

Amounts brought forward,			$90,203 15
Bath-house — *Con.*			
Brooms and brushes,	25 84		
Expenses of employees,	24 15		
Traveling,	20 00		
Steel letters and numbers,	14 11		
Findings,	6 53		
Bond renewal,	6 00		
Rubber bands,	3 63		
Brass checks,	3 60		
Advertising,	3 15		
Miscellaneous,	1 56		
		$22,990 98	
Repairs to buildings,		17,023 48	
Legal services,		50 00	
Advertising,		43 60	
Extending sewer,		35 28	
			40,143 34
			$130,346 49

Summary of General Expense for Year ending Nov. 30, 1920.

	Parks System Maintenance.	Parks Boulevard Maintenance.	Parks Expense Fund.	Parks Loan Fund.	Parks Loan Fund, Series II.	Totals.
Commissioners,	$2,500 00	$2,500 00	–	–	–	$5,000 00
Office salaries,	10,054 84	10,423 79	–	–	–	20,478 63
Engineering,	12,249 61	12,196 25	$110 38	–	–	24,556 24
Police,	183,528 84	82,317 97	965 00	–	–	266,811 81
Rent and care, Boston office,	3,980 02	5,125 54	–	–	–	9,105 56
Miscellaneous,	4,649 99	4,359 83	–	–	–	9,009 82
Totals,	$216,963 30	$116,923 38	$1,075 38	–	–	$334,962 06

Summary of Expenditures for Year ending Nov. 30, 1920.

	Metropolitan Parks Loan Fund.	Metropolitan Parks Loan Fund, Series II.	Metropolitan Parks System Maintenance.	Metropolitan Parks Boulevard Maintenance.	Metropolitan Parks Expense Fund.	Special Appropriations, Repairs, Construction and Investigations.	Band Concerts.	Totals.
Reservations: —								
Blue Hills,	–	–	$123,099 17	–	$4,318 49	–	$1,600 37	$129,018 03
Beaver Brook,	–	–	3,679 65	–	–	–	–	3,679 65
Charles River, Upper Division,	$450 00	–	72,712 20	–	1,045 35	–	2,609 00	76,816 55
Lynn Shore,	–	–	17,309 47	–	956 45	–	–	18,265 92
Middlesex Fells,	–	–	81,901 38	–	990 97	–	3,085 76	85,978 11
Mystic River,	850 00	–	17,855 67	–	–	–	–	18,705 67
Neponset River,	–	–	1,523 61	–	–	–	–	1,523 61
Quincy Shore,	–	–	19,064 55	–	1,221 82	–	–	20,286 37
Revere Beach,	–	–	58,806 75	–	40,794 75	–	4,614 94	104,216 44
Riverside Recreation Grounds,	–	–	7,241 89	–	–	–	–	7,241 89
Stony Brook,	–	–	12,896 77	–	31 43	–	–	12,928 20
Winthrop Shore,	–	–	11,648 71	–	9,416 53	–	–	21,065 24
General expense,	–	–	216,963 30	–	–	–	–	216,963 30
Totals,	$1,300 00	–	$644,703 12	–	$58,775 79	–	$11,910 07	$716,688 98

Parkways: —								
Alewife Brook,	–	–	–	$15,361 48	$3,231 26	–	–	$18,592 74
Blue Hills,	–	–	–	17,683 09	1,176 01	–	–	18,859 10
Dedham,	–	$19,775 77	–	–	–	–	–	19,775 77
Fresh Pond,	–	–	–	3,341 25	–	–	–	3,341 25
Furnace Brook,	–	30,975 19	–	14,736 56	–	–	–	45,711 75
Hammond Pond,	–	–	–	1,535 18	–	–	–	1,535 18
Lynn Fells,	–	–	–	5,773 17	119 60	–	–	5,892 77
Lynnway,	–	–	–	14,383 64	–	–	–	14,383 64
Middlesex Fells,	–	–	–	51,639 01	336 45	$15,696 29	–	67,671 75
Middlesex Fells Roads,	–	14,568 14	–	22,436 83	–	–	–	37,004 97
Mystic Valley,	–	–	–	40,365 48	838 77	–	–	41,474 25
Nahant Beach,	–	245 98	–	9,811 63	10,037 21	–	$1,438 80	21,533 62
Neponset River,	–	–	–	1,441 64	–	–	–	1,441 64
Nonantum Road,	–	38,102 67	–	–	–	–	–	38,102 67
Old Colony,	–	14,141 86	–	–	45	–	–	14,142 31
Revere Beach,	–	–	–	65,337 12	594 45	–	–	65,931 57
West Roxbury,	–	44,855 00	–	–	–	673 58	–	45,528 58
Winthrop,	–	18,655 73	–	923 69	11,847 05	–	–	31,426 47
Woburn,	–	–	–	5,390 11	74 50	–	–	5,464 61

Summary of Expenditures for Year ending Nov. 30, 1920 — Concluded.

	Metropolitan Parks Loan Fund.	Metropolitan Parks Loan Fund, Series II.	Metropolitan Parks System Maintenance.	Metropolitan Parks Boulevard Maintenance.	Metropolitan Parks Expense Fund.	Special Appropriations, Repairs, Construction and Investigations.	Band Concerts.	Totals.
Parkways—*Con.*								
Neponset Bridge,	–	$13,358 63	–	$12,663 77	–	–	–	$26,022 40
General expenses,	–	–	–	116,923 38	$60 65	–	–	116,984 03
Totals,	–	$194,678 97	–	$400,017 03	$28,316 40	$16,369 87	$1,438 80	$640,821 07
Nantasket Beach Reservation,	–	–	–	–	40,143 34	66,385 92	6,652 00	113,181 26
Wellington Bridge,	–	–	–	–	–	15,397 61	–	15,397 61
Charles River Basin,	–	–	–	–	1,897 50	185,077 09	–	186,974 59
Bunker Hill Monument,	–	–	–	–	138 08	10,439 27[1] 20,114 11	165 50	30,856 96
Grand totals,	$1,300 00	$194,678 97	$644,703 12	$400,017 03	130,346 49	$313,783 87	$20,166 37	$1,704,995 85

[1] Maintenance.

REPORT OF THE DIRECTOR AND CHIEF ENGINEER OF WATER DIVISION.

JAMES A. BAILEY, *Commissioner, Metropolitan District Commission.*

SIR: — I have the honor to submit the following report of the construction and maintenance operations of the Water Division for the calendar year 1920.

ORGANIZATION.

The principal assistants employed in directing and supervising the work of the Division at the close of last year have continued in service for another year and are as follows: —

John L. Howard,	Deputy Chief Engineer.
Elliot R. B. Allardice,	Superintendent of Wachusett Section.
Frank S. Hart,	Superintendent of Sudbury Section.
Samuel E. Killam,	Superintendent of Distribution Section.
Arthur E. O'Neil,	Superintendent of Pumping Stations.
Alfred O. Doane,	Engineer in charge of Mechanical Engineering and Inspection.
William W. Locke,	Sanitary Inspector of Watersheds.
Clifford Foss,	Engineer in charge of Distribution Civil Engineering.
Benjamin F. Hancox,	Head Draftsman.
James W. Killam,	Assistant Engineer in charge of Coal and Oil Laboratory.
William E. Whittaker,	Chief Clerk in charge of General Office.
Charles E. Livermore,	Biologist in charge of Biological Laboratory.

Including these principal assistants the number of supervising, engineering and clerical employees was 44 at the beginning of the year and 45 at the end of the year.

In addition to these forces the labor forces engaged in maintaining and operating the reservoirs, aqueducts, pipe lines, hydro-electric stations and pumping stations and doing miscellaneous construction work has been as follows: —

Section.	Number of Employees.			
	Beginning of Year.	End of Year.	Maximum.	Average.
Wachusett section,	50	48	75	58
Sudbury section,	68	74	75	71
Distribution section,	93	102	103	95
Pumping stations,	74	74	75	71
Total labor forces,	285	298	328	295

CONSTRUCTION.

Meters and Connections.

Under the provisions of chapter 172 of the General Acts of 1916 some minor work has been done in Washington Street, Brookline, on the low-service pipe lines acquired from the city of Boston in 1913. At the close of the year 1919 the work at this place had been completed, with the exception of installing the meter registers and repairing the street. On account of delay in receiving the registers the meters were not put into service until November 10, 1920, and on account of unfavorable conditions at that time the work of permanently repairing the street pavement was deferred, with the expectation that it would be done early in 1921.

Northern Extra High-service 16-inch Pipe Line for Lexington.

At the close of the year 1919 the northern extra high-service 16-inch pipe line for Lexington had been completed, with the exception of laying 204 feet of pipe line near the Arlington standpipe, and connecting the ends of the new pipe line with the distribution system. This work was completed by the permanent pipe line force of the Division, and the new line was put into service May 27, 1920.

June 11, 1920, a contract was made with John A. Gaffey of Medford for rebuilding the tarvia macadam roadway on the southerly side of Massachusetts Avenue for a distance of about 1,000 feet easterly from the Lexington boundary line, where it had been disturbed by blasting in constructing the pipe line. This work was completed on July 27 at a cost of $3,031.80.

The total expenditures for the pipe line amount to $43,871.

Southern Extra High-service 12-inch Pipe Line for Hyde Park and Milton.

The construction of the southern extra high-service 12-inch pipe lines in Poplar Street, West Roxbury, and across the Neponset River at West Street for Hyde Park and Milton was authorized by chapter 172 of the General Acts of 1916, and chapter 165 of the General Acts of 1919. The flexible jointed pipes purchased in 1918 for the duplicate line across the river were not laid in 1920 because of unfavorable conditions. It is planned to lay these pipes during the coming summer.

The 12-inch pipe line in Poplar Street, which was nearly completed in 1919, was connected to the existing distribution lines by the permanent pipe line force of the Division, and was put into service December 31, 1920.

New Work authorized during 1920.

Chapter 530 of the Acts of 1920 provides for an expenditure of $250,000 for the installation of additional pumping equipment for the northern high service; of $200,000 for the installation of additional pumping equipment for the southern high service; of $175,000 for replacing the Arlington standpipe by an enclosed reservoir of larger capacity; of $280,000 for reinforcing the northern high-service pipe lines; and of $1,800,000 for a supply main from the Weston Aqueduct to the northern low-service district.

For the northern high-service pumping station at Spot Pond plans have been made for installing a steam turbine driven centrifugal pump having a capacity of about 22,000,000 gallons a day for pumping to the Fells Reservoir, with a connected auxiliary centrifugal pump for repumping about 4,000,000 gallons a day from the discharge of the main pump to the Bear Hill Reservoir. The installation of two additional vertical fire tube boilers is also contemplated as the existing boilers have been in service over twenty-one years.

The proposed pumping unit can be installed for 25 per cent of the cost of a high-duty, triple expansion pumping engine, and as it will be held in reserve for emergencies and will not be used regularly low cost of installation is of more importance than high duty.

For the southern high-service pumping station at Chestnut Hill Reservoir plans have been made for replacing an old battery of

three horizontal return tubular boilers 64 inches in diameter with two vertical fire tube boilers 98 inches in diameter, and for replacing the old compound duplex Gaskill pumping engine, known as No. 2, which has a capacity of 8,000,000 gallons a day, with a horizontal cross compound crank and flywheel pumping engine of a capacity of 15,000,000 gallons a day.

May 27 a contract was made with the D. M. Dillon Steam Boiler Works of Fitchburg for furnishing the new boilers for the sum of $19,790. August 25 a contract was made with the Ames Iron Works of Oswego, New York, for furnishing a 35-kilowatt electric lighting unit for the sum of $3,649. October 29 a contract was made with the Worthington Pump and Machinery Corporation of New York for furnishing the new pumping engine for the sum of $75,900. Satisfactory progress has been made under all of these contracts.

Surveys and plans have been made for the Arlington Reservoir and for the proposed northern high-service pipe lines, but construction work has not yet been begun on these projects.

MAINTENANCE.

Rainfall and Yield of Watersheds.

The precipitation on the watersheds was unusually large during 1920. The total for the Wachusett watershed was 55.66 inches, and 10.34 inches above the average for the past twenty-four years; the total for the Sudbury watershed was 48.66 inches, and 4.04 inches above the average for the past forty-six years; and the total for the Cochituate watershed was 50.75 inches, and 5.51 inches above the average for the past fifty-eight years. The monthly precipitation was less than the average during January, August and October on all of the watersheds; also during July on the Sudbury and Cochituate watersheds, and during May on the Cochituate watershed.

The percentage of rainfall collected was 61.7 on the Wachusett watershed, 53.6 on the Sudbury watershed, and 58.2 on the Cochituate watershed.

The annual yield of all of the watersheds was above the average during 1920. The amount in gallons per day per square mile was 1,629,000 on the Wachusett watershed, 1,239,000 on the Sudbury watershed, and 1,403,000 on the Cochituate watershed. The monthly yield was below the average on all of the watersheds in January,

February, August and October, and was also below the average on the Sudbury watershed in November, and on the Cochituate watershed in September.

Between June 15 and December 15 the city of Worcester discharged 126,500,000 gallons of water into the Wachusett Reservoir watershed from the 9.35 square miles formerly tributary to the reservoir, and which the city diverted for its water supply in 1911. In accordance with the agreement of November 2, 1914, the Commonwealth will pay the city of Worcester for this water at the rate of $2 per million gallons. The city also discharged 2,051,100,000 gallons of water from the diverted area into the Wachusett Reservoir watershed at other times during the year for which no compensation will be paid, as the reservoir filled before June 15.

Storage Reservoirs.

The capacities of the storage reservoirs of the Metropolitan Water Works, the elevation of the water surfaces, and the quantity of water stored in each reservoir at the beginning and at the end of the year are shown by the following table: —

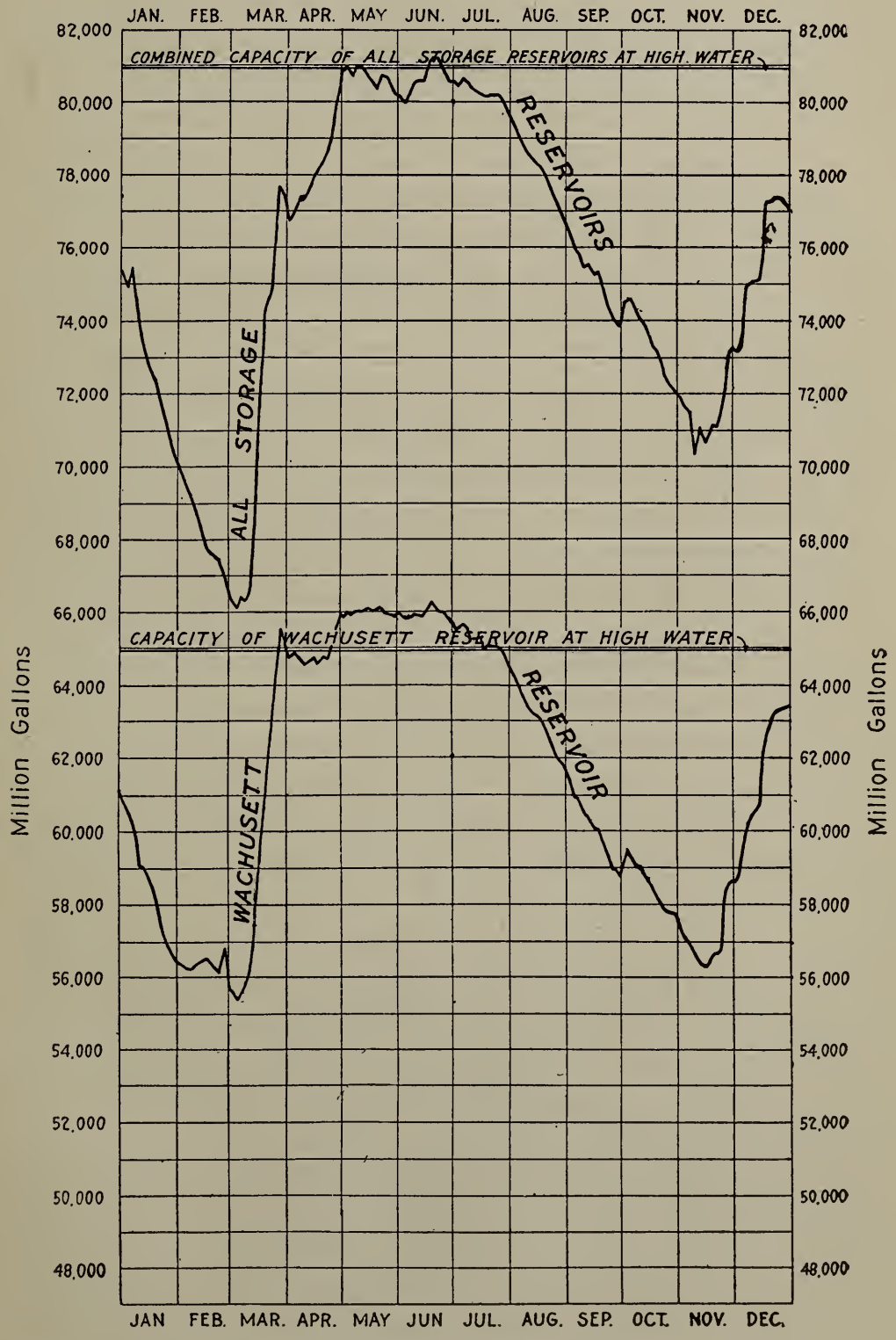
Storage Reservoirs.	Elevation[1] of High Water.	Capacity (Gallons).	Jan. 1, 1920.		Jan. 1, 1921.	
			Elevation[1] of Water Surface.	Amount stored (Gallons).	Elevation[1] of Water Surface.	Amount stored (Gallons).
Cochituate watershed: —						
Lake Cochituate,[2] . .	144.36	2,097,100,000	143.96	2,002,100,000	142.48	1,655,600,000
Sudbury watershed: —						
Sudbury Reservoir, .	260.00	7,253,500,000	258.01	6,425,900,000	257.73[3]	6,317,000,000
Framingham Reservoir No. 1.	169.32	289,900,000[4]	167.85	222,600,000	167.83	221,700,000
Framingham Reservoir No. 2.	177.87	529,900,000[4]	176.08	485,200,000	176.09	485,600,000
Framingham Reservoir No. 3.	186.74	1,180,000,000[4]	186.84	1,207,900,000	186.04	1,142,700,000
Ashland Reservoir, .	225.21	1,416,400,000	224.42	1,372,900,000	224.44	1,374,000,000
Hopkinton Reservoir, .	305.00	1,520,900,000	304.06	1,462,100,000	304.13	1,466,500,000
Whitehall Reservoir, .	337.91	1,256,900,000	336.65	1,013,300,000	336.43	971,400,000
Farm Pond, . . .	159.25	167,500,000	158.40	122,200,000	159.03	155,700,000
Wachusett watershed: —						
Wachusett Reservoir, .	395.00	64,968,000,000	392.03	61,013,500,000	393.75	63,292,000,000
Totals, ...	–	80,680,100,000	–	75,327,700,000	–	77,082,200,000

[1] Elevation in feet above Boston City Base.
[2] Excluding Dudley Pond which was abandoned April 3, 1916.
[3] Below Circular Dam.
[4] To top of flashboards.

The diagram on page 59 shows the quantity of water stored in the Wachusett Reservoir, and the quantity stored in all the storage reservoirs combined during the year.

The table and diagram show the total storage which could be drained from the reservoirs. Special provisions would be necessary, however, to draw about 10,000,000,000 gallons of this storage for consumption, as it is below the outlet channels which can be conveniently used for regular service.

QUANTITY OF WATER STORED IN THE WACHUSETT RESERVOIR AND IN ALL THE STORAGE RESERVOIRS COMBINED DURING 1920



Wachusett Reservoir.

At the beginning of the year the water in the Wachusett Reservoir was 2.97 feet below elevation 395, the designed high-water line, and the quantity in storage was 61,013,500,000 gallons. On account of the high stage of the water, the wasting of water from the reservoir, which was begun in December, 1919, in order to reserve storage capacity for controlling the spring freshet flows and to conserve water power, was continued to the extent warranted by the conditions. On March 5, 1920, the water had been drawn down to elevation 387.53, the lowest stage reached during the year. The quantity in storage was then 55,209,600,000 gallons. Following a period of thaws and rains the water rose rapidly and filled the reservoir to elevation 395 on March 27. The water remained substantially at or above this elevation until July 26. The highest stage reached was elevation 396.01 on June 18. The amount of water in storage was then 66,334,800,000 gallons. On March 28 water was wasted from the reservoir at a maximum rate of 980,000,000 gallons per day, — 538,000,000 gallons over the wasteway and 442,000,000 gallons through the waste pipes. On account of the high stage of the water in the reservoir, wasting of water was resumed October 22 to conserve power and reserve storage capacity for controlling the spring freshet flows in 1921, and the water was drawn down to elevation 388.4 on November 16, but on account of the heavy rains which followed, the water rose continuously, and at the close of the year had reached elevation 393.75, a higher stage than at the close of any previous year. The reservoir then contained 63,292,000,000 gallons of water.

During the year 22,317,600,000 gallons of water, or about 34 per cent of the capacity of the reservoir, were wasted into the Nashua River in addition to 616,700,000 gallons discharged from the reservoir, in accordance with the provisions of chapter 488 of the Acts of 1895, and 7,757,700,000 gallons of this water were utilized for the generation of electric energy.

The usual work of removing material which had drifted into the reservoir with the water and was deposited along the shore, and of cutting and burning brush and weeds growing along the margins of the reservoir, the sides of adjacent highways, and along brooks and rivers which flow directly into the reservoir, has been done at a cost of $7,184.01. This work extended over a distance of about 65 miles.

Wire fences were erected along property lines and highways for a distance of 6,762 linear feet at a cost of 29.7 cents per linear foot, exclusive of posts which were obtained from the water works lands.

The crest of the circular concrete dam at the head of the Quinapoxet basin was temporarily repaired by filling the cracks and joints with Portland cement grout and patching the badly worn portions of the exposed surface with Portland cement mortar at a cost of $122.18.

The engine in the motor patrol boat, which had been in service for twelve years, was rebuilt, and the patrol boat and motor work scow have been operated and kept in good serviceable condition at a cost of $463.46.

A 1-ton G. M. C. motor truck was purchased for $2,142.75 for transporting men, tools and supplies.

Standing and rowen grass were sold at auction from about 365 acres of water works lands bordering on the reservoir and its tributary streams for an aggregate amount of $3,464.50.

Three horses and wagons, sleds and equipment formerly rented from the foremen were purchased on December 1, and are now maintained by the Commonwealth.

The Wachusett Dam and adjacent structures and grounds have been given the usual care, and, with the exception of the granolithic walk on the dam and the roof of the gate chamber and of the power house, are in good repair.

Bids were received August 30 for extensive repairs to the roof of the power house, but because of the high prices only temporary repairs were undertaken, and the permanent repairs were postponed until a more favorable time.

The original hard pine plank floor of the bridge at the wasteweir, built in 1905, was relaid with prime quality, long leaf, Georgia pine planking $3\frac{7}{8}$ inches in thickness, at a cost of $1,011.66 for the lumber and $499.78 for labor and hardware. The bridge is 452 feet long by 5 feet wide, and the work included removal and relaying of a narrow-gage track on which the flashboards are transported in a small car, and the construction of trap doors opening on hinges through which the flashboards are put on the wasteway or removed, as required.

The guard rail fence on the westerly side of the roadway to the power house, built of stone posts and hard pine rails 4 inches by

4 inches, was lined up and repaired for the entire length of 1,180 linear feet at a cost of $328.66.

Considerable extra expense was involved in the care of the grounds and structures during January, February and March because of the unusual depth of snow.

Nine houses on the reservoir lands, and the barns and other buildings located at these premises and at the Clinton and Oakdale storage yards, which are owned by the Commonwealth, have been kept in good condition. At the Kramer house in Clinton storm vestibules and doors were built. At the Kendall place in Boylston an electric pump and storage tank were installed, a bathroom was provided, a hardwood floor was laid in the kitchen, and alterations were made in the heating system at a cost of $1,268.11. At the Cook place in West Boylston two rooms were renovated, an electric pump and storage tank were installed, and the bathroom was fitted with modern fixtures at a cost of $898.89.

Sudbury Reservoir.

At the beginning of the year the water in the Sudbury Reservoir was at elevation 258.01, or about 1 foot below the crest of the overflow at the dam. By March 11 it had been drawn down to elevation 254.25 to provide storage for use in regulating the freshet flows which were expected with the melting of the large amount of snow on the watershed. During the latter part of March the water was allowed to rise, and the flashboards were placed on the overflow April 16. During the summer and fall the water in the reservoir was maintained between the crest of the overflow and a few inches below the top of the flashboards. In November the water was lowered, and the flashboards were removed on the 15th. The water was then maintained just below the crest of the overflow, and was at elevation 257.73 at the end of the year. No water was wasted during the year, and all water discharged from the reservoir into the Weston Aqueduct and Framingham Reservoir No. 3 was used in generating electric energy. A channel was kept open in the ice back of the overflow during the winter, as usual, to prevent ice pressure on the masonry.

The usual care has been taken to keep the grounds and structures at the reservoir in good condition. About 15 tons of hay were cut, of which 6 tons were furnished for use at Lake Cochituate and

the Weston Aqueduct, and the remainder stored in the barn at the reservoir.

A new boat was purchased for use on the reservoir.

On account of incurable sickness horse No. 40, which had been used at the reservoir for over ten years, was killed and replaced by a new horse, No. 44. A new one-horse tip cart was also purchased.

A new pump was installed at the Cratty house in Fayville. Bathrooms were provided for the two tenements in the house at the Sudbury Dam, a closet was also constructed for the upper tenement and a storm porch for the lower tenement, and a storage closet for electrical supplies was constructed in the barn.

Sprouts and brush have been cut and burned in the lanes along the property lines, along highways and the driveways over Pine Hill, along the shores of the reservoir, and on the road from the dam to the nursery.

The wire fence, 1,100 feet in length, along the boundary lines at the Robert A. Clarke land at the north side of the reservoir, was rebuilt. A new wire fence, 216 feet in length, was built on the boundary line at the Anna Morse land on Marlborough Brook, north of Walker Street.

Framingham Reservoir No. 3.

All of the water supplied through the Sudbury Aqueduct to the Metropolitan Water District and town of Framingham was drawn from Framingham Reservoir No. 3, which was replenished with water from the Sudbury Reservoir as required. The draft for water supply from the reservoir was continuous excepting for fifteen hours on October 19 and for eighteen hours on October 26, and 27,587,000,000 gallons of water were drawn from the reservoir for a part of the water supply of the town of Framingham and of the Metropolitan Water District during the year.

Flashboards were kept on the overflow at the dam all of the year. The water was maintained between elevation 183.07 and 187.68. About 8,775,700,000 gallons of water were wasted from the reservoir during the year.

The gatehouse, embankments, shrubs and grounds at the dam were given the usual care. Sprouts and brush were cut along the shores of the reservoir and in the lanes along the property lines.

Framingham Reservoirs Nos. 1 and 2, Ashland, Hopkinton and Whitehall Reservoirs.

No water was drawn from Framingham Reservoirs Nos. 1 and 2, Ashland, Hopkinton and Whitehall reservoirs, for supplying the Metropolitan Water District during the year, but all of the reservoirs have been kept substantially full of water except when drawn down in the spring in anticipation of large yields, so that the freshet flows could be regulated and properly controlled.

The usual waste of 1,500,000 gallons per day from Framingham Reservoir No. 1 into the Sudbury River has been maintained, as required by chapter 177 of the Acts of 1872.

The usual attention has been given to the dams, gate houses and other structures and to the grounds at these reservoirs. Brush and sprouts have been cut and burned in the lanes along the boundary lines of the water works lands.

At Framingham Reservoir No. 1 the Bullard house was wired for electric service and painted inside and outside. The house, attached barn, tool house and sheds were shingled, and the tool house and flashboards for the dam were painted.

At Framingham Reservoir No. 2 the flashboards and ironwork at the dam were painted, and some resurfacing was done on the portion of Fountain Street which crosses the reservoir and is under the care of the Water Division.

At Ashland Reservoir the flashboards and the ironwork at the dam and the bridge over the overflow have been painted, and a new cesspool for sink drainage has been constructed at the attendant's house.

At Hopkinton Reservoir the flashboards at the outlet dam, and the gates and their housings, have been painted.

At Whitehall Reservoir the overflow at the middle dam at Wood Street and the bank walls along the brook below Wood Street were repaired and the brook channel was straightened. The town of Hopkinton pumped about 2,100,000 gallons of water from Whitehall Reservoir at various times to supplement its regular supply.

Farm Pond.

No water was diverted into Farm Pond or wasted from the pond during the year. The elevation of the water in the pond has been higher than at any time since 1908. Under rights reserved by legis-

lation the town of Framingham pumped 220,300,000 gallons of water from its filter galleries on the northeasterly shore of the pond, and the Boston & Albany Railroad took approximately 85,700,000 gallons and the New York, New Haven & Hartford Railroad approximately 53,700,000 gallons of water from the pond for the use of locomotives during the year.

The wooden cover at the gate chamber of the new south dam across the outlet was repaired and painted and the platform at the sluiceway at the outlet from the pond was repaired.

Lake Cochituate.

On account of the limited capacity of the Sudbury Aqueduct and the Weston Aqueduct supply mains, Lake Cochituate and the Cochituate Aqueduct were as usual kept in good condition for use in case of an emergency which would prevent the use of the Sudbury or the Weston Aqueduct. Such an emergency occurred unexpectedly about the middle of October, when it was discovered that the screens and supporting framework in the gatehouse of the Sudbury Aqueduct at Farm Pond had become unsafe and should be removed without further delay. In order to remove the structures it was necessary to shut off the flow in the Sudbury Aqueduct, and in connection with this operation 287,900,000 gallons of water were drawn from Lake Cochituate between October 15 and November 13 for water supply.

Water was wasted at the outlet dam through the gate and at the overflow on all the days in January, February and March, all but four days in April, all of May and June, all but three days in July, on one day in September, five days in October, five days in November and all of December. The total waste amounted to 8,321,100,000 gallons.

High-water line at the lake is elevation 144.36. The water in the lake was at elevation 143.96 at the beginning of the year and at elevation 142.48 at the end of the year.

With the expectation that a large and sudden yield might result from the melting of the large depth of snow on the watershed the stop planks on the outlet dam were entirely removed for the first time since the dam was built, to make sure of ample capacity to waste the large yield expected, and the water was drawn down to 2.31 feet below the crest of the overflow, leaving the water 5.20 feet above the sill of the small outlet gate, which is only 3.8 feet

wide. Fortunately the snow on the watershed melted gradually, and it was not necessary to waste water from the lake at an excessive rate at any time.

Brush and sprouts were cut and burned from the 5-foot lanes on the property lines and along the shores of the lake and of Snake Brook. Sediment was removed from the catch basins on the covered portion of the surface water drain from Cochituate village; brush and weeds were mowed for a width of 10 feet on both sides of the open channel portion, and the sediment was removed from the channel and the settling basin at the junction of Bannister's Brook.

The foreman's house was painted one coat and the roof of the house and piazza were shingled. The shed, shop and barn were painted and shingled. The iron and wood work at the outlet dam was painted, and stop planks were provided for the overflow. The iron and wood work and the tin roof at the gatehouse were also painted.

A 1½-ton Stewart truck was purchased for carrying supplies.

Aqueducts.

Wachusett Aqueduct.

Water was discharged through the Wachusett Aqueduct from the Wachusett Reservoir on 302 days. The total time that the aqueduct was in use is equivalent to 189 days, 22 hours and 27 minutes. The total quantity of water discharged is 41,476,800,000 gallons, equivalent to an average of 113,325,000 gallons per day for the entire year. Of this total 38,572,100,000 gallons were used to generate electric energy at the power station before being discharged into the aqueduct.

The Westborough State Hospital pumped 72,983,000 gallons of water from the aqueduct at the terminal chamber during the year. This is equivalent to a consumption of 199,400 gallons per day, which is the largest since pumping began, nine years ago, and the increase is probably due in large measure to the additional pressure maintained on the distribution system since the new and higher water tank was constructed in 1919.

The masonry aqueduct, open channel and appurtenances are in good condition, with the exception of the Assabet bridge, which requires waterproofing to stop the leakage which has developed during recent years, and a new granolithic walk on the top of the bridge.

Wire fences have been erected on property lines for a length of 6,027 feet between Main and Maple streets in Northborough. Short portions of this fence replaced the original board rail fence erected in 1897. The remainder was built along property lines not previously fenced and was necessary at this time because the owners now use the adjacent lands for pastures.

The iron rail and picket fences at the upper and lower dams and at the six highways crossing the open channel in Marlborough and Southborough, the iron and wood work at the terminal chamber, and the pipe rail fences on the Assabet bridge and along the highway at Bartlett Pond, Northborough, have been painted.

Brush, grass and weeds were mowed and disposed of for a distance of 10 miles along the aqueduct at a cost of about $350 per mile. This is almost double the cost of this work last year and is due to mowing large areas along the open channel, which have not been mowed for several years, and to an increase of about 20 per cent in wages. Considerable extra expense was incurred during the unusually severe weather in January, February and March in keeping the culverts and ditches free from snow and ice.

Sudbury Aqueduct.

During the year 27,587,000,000 gallons of water were discharged from Framingham Reservoir No. 3 into the Sudbury Aqueduct, of which 186,500,000 gallons were pumped from the aqueduct by the town of Framingham for a portion of its supply. The remainder of the water, equivalent to an average flow of 74,865,000 gallons per day, was discharged into the Chestnut Hill Reservoir, from which it was pumped to supply a portion of the Metropolitan Water District.

In October the flow in the aqueduct was shut off to examine the screens and the frames supporting them, which had been in service since 1898, in the aqueduct gatehouse at Farm Pond, and as the examination showed that it was unsafe to use the screens and the framework they were removed on the 19th and 26th of October.

The flow in the aqueduct has been measured monthly with a rated current meter to determine the condition of the interior surface of the aqueduct so that the daily flow could be calculated from the elevation of the water, shown by the recording gage in the aqueduct gatehouse at Farm Pond. The measured flows have varied from 86.68 to 95.56 per cent of the corresponding flow in the aqueduct when clean.

The plumbing and the plank walk at the office building on the aqueduct land at Hollis Street, Framingham, were repaired. Some painting was done at the storehouse near Rosemary siphon in Wellesley, at the Waban and Echo bridges and at the wasteweirs and siphon chambers. The plank walk at Echo bridge was renewed.

A rail fence 180 feet in length was built at Leach's Lane, South Natick, and the manhole covers were painted where necessary.

On account of the severe weather an unusual amount of work was required to keep the culverts free from snow and ice.

Brush, grass and weeds on the aqueduct lands were mowed and disposed of in the usual manner.

Weston Aqueduct.

Water was delivered to the Weston Reservoir from the Sudbury Reservoir through the Weston Aqueduct on 304 days, or every day except Sundays and holidays, and on July 16, when it was necessary to interrupt the flow on account of a break in one of the supply mains in Brookline. The water supplied to the aqueduct on the days when in use is delivered in a period of $15\frac{1}{2}$ hours unless the conditions require its delivery throughout the entire 24 hours, as was the case on 101 days. The total time that the aqueduct was in service during the year is equivalent to 210 days, 22 hours and 30 minutes, and the total quantity of water delivered to the aqueduct was 16,091,700,000 gallons, of which 1,600,000 gallons were wasted at the Sudbury River and Happy Hollow blow-offs on Sunday, November 21, in connection with the inspection of the interior of the steel pipe lines across these valleys. This pipe line is $7\frac{1}{2}$ feet in diameter, constructed of steel plates $\frac{7}{16}$ of an inch in thickness. The interior inspection showed that there were pittings $\frac{15}{100}$ of an inch in depth, which is 34.28 per cent of the total thickness. The pipes have been in service seventeen years, and the pittings have increased in depth $\frac{1}{10}$ of an inch in the twelve years since the previous inspection was made in 1908.

The total quantity of water delivered to the Weston Reservoir from the aqueduct is equivalent to an average flow of 43,962,000 gallons per day.

The brush, sprouts, weeds and grass along the aqueduct and property lines have been mowed and disposed of as usual.

Over 10,600 feet of fencing have been repaired and put into good condition, using about 600 new posts and 7,300 feet of wire fencing.

The iron manhole covers and the iron and wood work at the gaging chambers, at the siphon chambers and the head house have been painted. Culverts along the aqueduct were kept free from ice and snow and sediment collecting in them was removed.

Cochituate Aqueduct.

The Cochituate Aqueduct was in use on 17 days in October and 12 days in November and during this time 287,900,000 gallons of water were delivered from Lake Cochituate to Chestnut Hill Reservoir.

The manhole covers and the ironwork at the wasteweirs were painted. Eighty feet of rail fence was built at Forest Street, Wellesley. The fences on both sides of the right of way across the aqueduct at W. W. McLeod's premises in Wellesley Hills were rebuilt, also the party fence on the southeast side of the aqueduct, one-half of the expense for this fence being paid by Mr. McLeod.

Brush, grass and weeds along the aqueduct were mowed and disposed of. The culverts were kept clear of snow and ice during the winter and the sediment was removed when necessary.

Protection of the Water Supply.

Sanitary Inspection.

A sanitary inspector, two watershed inspectors and one temporary and three permanent watchmen were employed to prevent pollution of the water supply. Their duties include the inspection of ice-cutting operations and fishing through the ice at various reservoirs and ponds where such operations are permitted during the winter; the prevention of bathing and unauthorized boating and fishing in the reservoirs during the summer; examination of condition of premises on the watersheds; and the obtaining of information for a sanitary census which is taken every five years.

The following tables contain a summary of the sanitary inspections and of the sanitary census by districts for 1920; also a summary of the sanitary census of 1915 for each watershed for comparison: —

Summary of Sanitary Inspections on the Wachusett Watershed in 1920.

DISTRICT.	Number of Premises Inspected.	Classification of Cases inspected.[1]													Condition at End of Year.	
		Cesspools dug before 1920.	Cesspools dug during 1920.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.		Barn Drainage.		Manufacturing Wastes.	Premises Vacant.	No Drainage.	Drainage carried to Filter Beds.		
							Satisfactory.	Unsatisfactory.	Satisfactory.	Unsatisfactory.					Satisfactory.	Unsatisfactory.
French Brook,	66	48	–	–	–	–	16	–	26	–	–	2	–	–	66	–
Muddy Brook,	44	27	2	–	–	–	11	–	22	–	–	2	–	1	44	–
Gates Brook,	218	179	2	–	1	–	23	3	43	1	–	10	2	–	215	3
Malden Brook,	34	19	3	–	–	–	10	–	21	–	–	2	–	–	34	–
Chaffin Brook,	234	151	8	–	–	–	61	–	80	–	1	10	6	–	233	1
Asnebumskit Brook,	216	176	3	–	1	8	11	4	33	1	2	6	5	1	201	15
Muschopauge,	102	48	1	–	–	–	44	–	41	–	1	5	4	–	101	1
South Wachusett Brook,	86	36	–	–	–	–	37	–	34	1	–	11	3	–	85	1
Trout Brook,	34	8	1	–	–	–	16	–	23	–	–	7	2	–	34	–
East Wachusett Brook,	210	93	–	–	–	–	83	1	90	–	–	20	8	1	209	1
Stillwater River,	132	67	–	–	–	–	49	2	63	1	–	5	9	1	130	2
Waushacum,	322[2]	122	8	–	–	–	61	2	50	2	–	6	14	100	319	3
French Hill,	36	29	–	–	–	–	5	–	15	–	–	–	2	–	36	–
Totals,	1,734	1,003	28	–	2	8	427	12	541	6	4	86	55	104	1,707	27

[1] On some premises there are two or more cases.

[2] Including 108 summer dwellings at Sterling camp ground, not classified.

Summary of Sanitary Inspections on the Sudbury and Cochituate Watersheds in 1920.

DISTRICT.	Number of Premises inspected.	Classification of Cases Inspected.[1]														Condition at End of Year.	
		Sewer Connections.	Cesspols dug before 1920.	Cesspools dug during 1920.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.		Barn Drainage.		Manufacturing Wastes.	Premises Vacant.	No Drainage.	Drainage carried to Filter Beds.	Satisfactory.	Unsatisfactory.
								Satisfactory.	Unsatisfactory.	Satisfactory.	Unsatisfactory.						
Sudbury Watershed.																	
Farm Pond,	328	317	1	–	–	–	–	–	–	11	–	–	7	2	–	328	–
Framingham Reservoir No. 3,	94	–	52	1	–	–	–	21	1	35	–	–	18	1	–	93	1
Stony Brook,	306	–	261	1	–	–	–	16	–	84	3	–	14	10	2	303	3
Angle Brook,	2,053	1,653	250	5	–	–	–	65	1	154	–	–	43	26	1,848	2,052	1
Framingham Reservoirs Nos. 1 and 2 and Cold Spring Brook,	350	–	255	5	–	–	–	44	–	88	–	–	35	8	–	350	–
Eastern Sudbury,	236	–	209	4	–	–	–	9	–	22	–	1	7	5	1	235	1
Indian Brook,	403	–	263	3	–	–	–	96	1	45	2	–	34	5	–	400	3
Western Sudbury,	186	–	117	2	–	–	–	40	3	53	1	1	18	8	–	182	4
Whitehall Reservoir,	185	–	62	5	–	–	–	89	–	31	1	–	23	6	–	184	1
Cedar Swamp,	795	528	185	4	–	–	–	29	1	115	–	–	27	18	–	794	1
Totals,	4,936	2,498	1,655	30	–	–	–	409	7	638	7	2	226[2]	89	1,851	4,921	15
Cochituate Watershed.																	
Snake Brook,	261	–	184	6	–	1	–	41	1	34	1	–	27	4	–	260	1
Pegan Brook,	1,103	786	244	1	–	–	–	24	–	39	–	1	31	16	1,025	1,103	–
Course Brook,	150	1	132	2	–	–	–	6	–	33	–	–	7	2	–	150	–
Beaver Dam Brook,	1,798	1,375	290	4	–	–	–	61	1	133	1	–	39	23	1	1,796	2
Totals,	3,312	2,162	850	13	–	1	–	132	2	239	2	1	104[3]	45	1,026	3,309	3

[1] On some premises there are two or more cases.

[2] Forty-two of these premises connected with the public sewer.

[3] Thirty of these premises connected with the public sewer.

Wachusett Watershed — Sanitary Census by Districts for 1920 and for entire Watershed for 1915 and 1920.

DISTRICT.	Premises.								Area (Square Miles including Water Surfaces).	Population.			Domestic Animals.					
	Number on which there are Dwellings occupied throughout the Year.	Summer Dwellings.	Number on which there are Stores or Other Buildings but no Dwellings.	Vacant.	Total Number.	Having Public Water Supply.	Having Private Water Supply.	Having no Water Supply.		Permanent.	Summer.	Permanent per Square Mile.	Horses.	Cattle.	Sheep.	Swine.	Poultry.	Dogs.
French Brook,	55	6	3	2	66	5	59	–	7.30	229	24	31.4	43	284	–	43	896	21
Muddy Brook,	38	2	2	2	44	–	42	–	3.41	166	19	48.7	28	158	39	29	618	15
Gates Brook,	196	1	11	10	218	5	201	2	3.93	918	8	233.6	61	194	76	97	2,464	55
Malden Brook,	28	4	–	2	34	–	32	–	3.05	145	20	47.5	36	124	–	63	850	17
Chaffin Brook,	208	9	7	10	234	99	119	6	10.56	972	35	92.0	92	290	1	127	5,789	88
Asnebumskit Brook,	189	1	20	6	216	192	13	5	3.61	1,123	197	311.1	54	100	–	148	2,543	55
Muschopauge,	79	12	6	5	102	8	85	4	11.88	395	101	33.2	64	290	–	99	1,566	51
South Wachusett Brook,	55	16	4	11	86	–	72	3	11.33	224	75	19.8	61	295	176	67	1,868	38
Trout Brook,	25	–	2	7	34	–	25	2	7.65	112	–	14.6	32	132	–	48	520	15
East Wachusett Brook,	134	43	13	20	210	–	182	8	20.88	551	311	26.4	153	479	6	141	3,527	93
Stillwater River,	109	7	11	5	132	–	118	9	11.87	557	31	46.8	103	544	3	140	2,941	38
Waushacum,	145	154	17	6	322	–	302	14	7.70	605	510	78.6	85	467	147	102	2,469	58
French Hill,	34	–	2	–	36	–	34	2	5.67	165	–	29.1	16	58	–	39	944	9
Totals for 1920,	1,295	255	98	86	1,734	309	1,284	55	108.84	6,162	1,331	56.6	828	3,415	448	1,143	26,995	553
Totals for 1915,	1,228	249	121	108	1,706	296	1,186	67	108.84	5,745	1,486	52.8	1,096	3,588	78	740	44,358	468

Sudbury and Cochituate Watersheds — Sanitary Census by Districts for 1920 and for Each Watershed for 1915 and 1920.

DISTRICT.	Premises.									Area (Square Miles including Water Surfaces).	Population.				Domestic Animals.					
	Number on which there are Dwellings occupied throughout the Year.	Summer Dwellings.	Number on which there are Stores or Other Buildings but no Dwellings.	Vacant.	Total Number.	Connected with Sewer.	Having Public Water Supply.	Having Private Water Supply.	Having no Water Supply.		Permanent.	Summer.	In dwellings not connected with sewer. Total.	In dwellings not connected with sewer. Per Square Mile.	Horses.	Cattle.	Sheep.	Swine.	Poultry.	Dogs.
Sudbury Watershed.																				
Farm Pond,	279	–	42	7	328	317	319	–	2	0.54	1,769	–	6	11.1	63	1	–	1	471	51
Framingham Reservoir No. 3,	73	2	1	18	94	–	–	75	1	5.35	279	11	279	52.1	61	317	3	41	1,594	28
Stony Brook,	265	6	20	15	306	–	–	281	10	13.29	1,321	46	1,321	99.4	171	890	1	149	5,057	129
Angle Brook,	1,888	1	121	43	2,053	1,653	1,899	85	26	9.16	11,576	7	1,692	184.7	305	308	3	276	9,833	392
Framingham Reservoirs Nos. 1 and 2, and Cold Spring Brook,	303	3	9	35	350	–	169	138	8	11.72	1,379	63	1,379	117.7	126	304	7	121	6,077	132
Eastern Sudbury,	206	1	22	7	236	–	201	23	5	3.11	1,079	3	1,079	346.9	44	33	–	44	1,386	49
Indian Brook,	340	8	21	34	403	–	271	93	5	7.17	1,372	35	1,372	191.4	64	168	1	44	3,440	84
Western Sudbury,	154	1	13	18	186	–	–	160	8	7.85	597	3	597	76.1	68	264	2	48	4,102	65
Whitehall Reservoir,	80	74	8	23	185	–	52	104	6	7.61	285	300	285	37.5	47	123	6	71	1,799	22
Cedar Swamp,	712	3	53	27	795	528	693	57	18	9.40	3,376	10	944	100.4	177	477	1	133	6,900	156
Totals for 1920,	4,300	99	310	227	4,936	2,498	3,604	1,016	89	75.20	23,033	478	8,954	119.1	1,126	2,885	24	928	40,659	1,108
Totals for 1915,	4,274	87	299	189	4,849	2,468	3,501	1,090	69	75.20	22,986	425	9,335	124.1	1,500	3,003	43	1,064	76,624	1,150
Cochituate Watershed.																				
Snake Brook,	169	63	2	27	261	–	216	14	4	3.58	643	212	643	179.6	32	142	–	25	1,401	62
Pegan Brook,	978	16	78	31	1,103	786	1,051	5	16	2.24	4,747	48	240	107.1	88	66	–	27	4,745	149
Course Brook,	139	–	4	7	150	1	85	56	2	3.61	788	–	588	162.9	73	276	3	66	2,932	54
Beaver Dam Brook,	1,625	25	109	39	1,798	1,375	1,574	162	23	8.15	11,578	66	1,757	215.6	189	272	17	402	10,606	365
Totals for 1920,	2,911	104	193	104	3,312	2,162	2,926	237	45	17.58	17,756	326	3,228	183.6	382	756	20	520	19,684	630
Totals for 1915,	2,728	168	185	125	3,206	2,036	2,729	317	35	18.51	16,911	649	4,039	218.2	662	835	21	487	34,734	662

During the year 25 cottages, 4 garages and 1 stable were constructed on lands adjoining the water works land at Lake Cochituate, and as 2 cottages were burned there are now on these adjoining lands 167 cottages, 22 garages and 3 stables.

There were 5 cottages constructed on land bordering on Whitehall Reservoir during the year, and the number of boats on the reservoir was increased by 3 rowboats and a motor boat during the year, making a total of 71 cottages, 88 rowboats, 6 motor boats and 26 canoes.

Filtration and Chlorination.

On the Wachusett watershed the surface water from 525 acres in the village of Sterling was filtered at the Sterling filter beds, except for five hours on March 14 when the inflow was greater than the capacity of the filters. The sewage from the Worcester County Training School, occupied by about 68 persons, was purified at the filter beds on Beaman Street in West Boylston. The Gates Terrace filter beds at Sterling Junction were operated throughout the year. The cost of maintaining all of these filters was $818.35.

On the Sudbury watershed the surface water from an area of 2 square miles in Marlborough was filtered at the Marlborough Brook filter beds before it entered the Sudbury Reservoir, with the exception that on six days, from March 13 to 18, inclusive, 65,600,000 gallons overflowed into Sudbury Reservoir after being sterilized with calcium hypochlorite.

At the combined storage reservoir and filter bed on Farm Road dilute sewage from the Marlborough main sewer was received on 23 days in March, 19 days in April, 13 days in May and 12 days in June. This unusual condition was due principally to the clogging up of the sewer to such an extent that prolonged overflow took place into the additional sewer before the Marlborough officials obtained suitable apparatus for cleaning out the main sewer. The ground water from the additional sewer flowed into settling basin No. 5 on every month in the year, and almost continuously from January 1 to the middle of September. The periodical cleaning out of the settling reservoir, which was deferred last year, was accomplished this year under favorable circumstances, and 2,486 cubic yards of sediment were taken out and sold to the owner of the adjoining lands.

The Southborough swimming pool, including appurtenant grounds, filter bed and drainage ditch, was cared for as usual.

The surface water from the brook which flows through the former Town Farm land on Pleasant Street, in Framingham, has all been diverted satisfactorily through the intercepting ditch constructed last year, and filtered at an old gravel pit before entering Framingham Reservoir No. 3.

The cost of filtration and chlorination on the Sudbury watershed was $6,893.18.

On the Cochituate watershed the surface water from the thickly settled area of 0.55 of a square mile tributary to Pegan Brook, and from an additional area of 0.54 of a square mile further north and tributary to the intercepting ditch, was pumped and filtered at the Pegan filtration works before entering Lake Cochituate, with the exception of about 32,000,000 gallons from Pegan Brook on 14 days in March, and about 78,000,000 gallons from the intercepting ditch on 25 days in March, 15 days in April, 1 day in May and 1 day in June, all of which overflowed directly into the lake after being sterilized with calcium hypochlorite.

The pumping station was operated on 266 days, and 299,945,000 gallons of surface water, equivalent to an average of 819,500 gallons per day for the entire year, were pumped to the filter beds. The cost of operating and maintaining the pumping station, grounds and filter beds was $5,967.74 for labor, $1,322.87 for fuel and $436.01 for supplies and expenses, making a total of $7,726.62, or at the rate of $25.76 per million gallons filtered. The cost per million foot gallons for fuel was 39 cents.

The grounds and filter beds are in good condition, but the pumping plant which has been in service for seventeen years is now obsolete and should be replaced by a modern plant of higher efficiency.

Improvement of Swamps and Brooks.

The ditches maintained in the swamps on the watersheds for improving the quality of the water were cleaned and weeds and brush mowed for a width of 10 to 20 feet on both sides where necessary, at a cost of $3,419 for the 27.73 miles of ditches connected with the Wachusett works, and a cost of $1,626.18 for the 8.94 miles connected with the Sudbury works. This last amount includes the

cost of making quite extensive repairs required because of the rotting out of the board substructure in many places, in repairing which it was necessary to remove and replace 570 square yards of stone paving and to relay 686 linear feet of new bottom boards and 889 linear feet of new timbers made from 4 inch by 4 inch joists split diagonally for supporting the toe of the stone paving.

Wire fences were built along the property line of the pasture of James B. McHale, adjacent to Big Crane Swamp in Northborough, for a length of 2,358 feet to keep the cattle out of the ditches.

The work of completing the improvement at Gates Brook in West Boylston was again deferred because of the high cost of labor and materials.

Purchase of Land.

For the protection of the water supply on the Wachusett watershed 6.507 acres of land on Main Street, Boylston, and in Waushacum Park, Sterling, were acquired during the year, and the clubhouse owned by the Clinton Outing Club, 3 summer cottages, 2 garages, a boathouse, pump house and other small buildings, and the water and lighting systems owned by Herbert C. Fisher, were removed from the water works property in Waushacum Park on Middle Waushacum Pond, in Sterling; but as the 3 cottages were removed to adjacent land at the close of the year, there were 8 summer cottages at Waushacum Park located on private land close to the water works land.

A small parcel of land located on the easterly shore of Whitehall Reservoir in the Sudbury watershed, containing .01 of an acre, was acquired to adjust the boundary of the water works land at this place.

Clinton Sewage Disposal Works.

Pumping Station.

On account of the large amount of surface water permitted to enter the sewer by the town of Clinton the inflow at times between March 13 and June 3 was greater than the pumping capacity, and sewage overflowed directly into the Nashua River, but at these times the overflow was diluted by discharging water into the river from the Wachusett Reservoir.

The sewage was pumped with the electrically driven 12-inch De-Laval centrifugal pump, and the quantity pumped is equivalent to

an average of 863,700 gallons per day. The energy for operating the pump was furnished from the Wachusett power station at all times except from June 3 to June 10, inclusive, while repairs were being made at the Wachusett power station, when the pump was operated with energy purchased from the Clinton Gas Light Company, which made an emergency connection with our feeder line and furnished 2,506 kilowatt hours for $137.83. The pumping statistics are as follows: —

Total pumpage (gallons),	316,109,000
Average pumpage (gallons per day),	863,700
Electric energy used (kilowatt hours),	106,704
Pumpage per kilowatt hour (gallons),	2,962
Average lift (feet),	49.6
Efficiency of pumping unit and transmission line (per cent),	51.4
Coal used for burning sludge and heating (pounds),	51,186

Cost of pumping: —

Labor,	$1,753 18
Electric energy from Wachusett power station at $5.30 per thousand kilowatt hours,	552 25
Electric energy purchased from Clinton Gas Light Company,	137 83
Coal for burning sludge and heating,	186 48
Repairs and supplies,	315 06
Total for station,	$2,944 80

Cost per million gallons,	$9.316
Cost per million foot gallons,	.18782

The 35-horsepower Blake & Knowles pumping engine with air pump and jet condenser, and the 50-horsepower locomotive type boiler installed in 1899, which were used for pumping the sewage at this station prior to the installation of the electric equipment in 1912, but were no longer serviceable, were sold in place to H. Aronofsky & Sons of Boston for $287.50. A portable hoisting engine boiler from the storage yard has been used to furnish steam temporarily for heating purposes until permanent heating apparatus is installed.

Filters.

After sedimentation in the settling basins to separate the liquid from the heavy portion of the sewage, about 80 per cent of the liquid was filtered on the 25 1-acre filter beds in regular doses of 57,000

gallons in 30 minutes at intervals of about $1\frac{1}{2}$ days, which is equivalent to an average rate of filtration of about 36,800 gallons per acre per day. The remaining liquid was drawn from the settling basins into the two $\frac{1}{2}$-acre sludge beds, where additional sedimentation and filtration took place.

The carrier distributors on 24 of the filter beds have been put into first-class condition by relaying portions of the concrete bottoms, replacing many of the iron brackets and supports, renewing or repairing the wooden sides and by painting where required.

The cost of filtration during 1920 was as follows: —

Labor,	$7,265 98
Supplies and expenses,	1,706 30
Total,	$8,972 28
Cost per million gallons,	$28 38

The character of the effluent from the filters for the past five years is shown by the following table: —

[Parts per 100,000.]

	1916.	1917.	1918.	1919.	1920.
Albuminoid ammonia, sewage,	1.0255	.8652	.8792	.6265	.7302
Albuminoid ammonia, effluent,	.0983	.1383	.1439	.0908	.0850
Reduction (per cent),	90	84	83.6	86	88
Free ammonia, sewage,	2.7850	3.4707	3.2300	3.0925	3.1120
Free ammonia, effluent,	1.0316	1.7658	1.5094	1.5571	1.6743
Reduction (per cent),	63	49	53	50	46
Nitrogen as nitrates, effluent,	.3693	.20165	.2866	.1818	.3098
Iron, effluent,	1.052	2.036	1.903	2.5644	2.099
Average quantity of sewage filtered (gallons per day).	1,225,000	1,050,000	1,037,000	1,168,000	863,700

The results show that the filters are of insufficient capacity to purify properly the large quantity of surface water and sewage now received from the sewers, but before making any further expenditures for enlarging the purification works it is desirable that the town of Clinton should exercise its authority under chapter 433 of the Acts of 1909 and require the removal of a large quantity of surface water and manufacturing wastes which now enter the sewers and prevent the satisfactory operation of the purification works.

Forestry.

Wachusett Lands.

Parcels of water works land bordering on the Wachusett Reservoir or its tributary streams in Clinton, Boylston and Sterling, which had recently been burned over or were grown to chestnut trees affected by the bark disease, having a total area of 61 acres, were cleared for planting with pine seedlings. This work cost about $51 per acre, but as railroad ties, fence posts and cordwood to the value of $1,908 were obtained, the net cost is about $20 per acre.

Water works land in Clinton, Boylston, West Boylston and Sterling, comprising 34 acres of the cleared areas and 17 acres requiring no preliminary clearing, were planted with 32,700 white pine seedlings five years old from the Oakdale nursery, and 19,700 red pine seedlings four years old from the Amherst nursery of the State Department of Conservation. The cost of preparing and planting the trees was $16.20 per thousand or $17.28 per acre.

Plantings along the margins of the Wachusett Reservoir in Clinton, Sterling and West Boylston, and along the shore of the open channel of the Wachusett Aqueduct in Southborough, aggregating 101 acres, were filled in, where the original trees had failed, with 18,500 white pine seedlings four to six years old from the Oakdale nursery, and 5,700 red pine seedlings four years old from the State nursery at Amherst.

Twelve hundred and ninety-one maple seedlings obtained from the woods on the water works lands were set out along main highways adjoining the Wachusett Reservoir to fill in where previous plantings had failed. This work cost $445.26.

At the end of the year the Oakdale nursery contained the following seedlings: —

White pine 2 years old in transplant beds,	1,800
White pine 3 years old in transplant beds,	12,300
White pine 4 years old in transplant beds,	35,400
Red pine 4 years old in transplant beds,	5,000
White spruce 9 years old in transplant beds,	7,000
Maple 4 years old transplanted from field,	325
Total,	61,825

Mature white pine and hemlock trees from scattering locations on the margins of the reservoir were cut into saw logs and made into lumber for repair work on swamp drainage ditches and miscellaneous work in connection with water works operations, at a cost of $1,252.47, and about 31,000 feet of lumber were secured at about one-half the prevailing retail price of the lumber.

The improvement thinning in Big Crane Swamp, Westborough, which was in progress at the beginning of the year, was continued until early in February, when it was suspended. About 2 acres of swamp land on which there was a thick growth of cedars was improved at a cost of $1,050.54. From this operation we obtained 1,200 fence posts and 44 cords of wood and logs, from which about 275,000 shingles will be obtained. The estimated value of these materials is $1,600.

The trees and shrubbery at the Wachusett Dam, and the trees on water works land adjacent to the main highways at the Wachusett Reservoir, Waushacum Pond and the Sterling and Clinton sewerage filter beds and on several large areas of forest land on the margins of the Wachusett Reservoir, which were badly infested with gypsy moths, were sprayed with 7,010 pounds of arsenate of lead during June and July at a cost of $1,866.82.

In January, February and December about 10,000 egg clusters of the gypsy moth, found on trees and shrubbery at the Wachusett Dam, were painted with creosote at a cost of $169.42.

During June, July and August many of the white pine plantings on the marginal lands around the reservoir and along the open channel of the Wachusett Aqueduct were inspected for the pine-tree weevil on two occasions, and about 27,800 infected shoots were cut and burned at a cost of $537.16.

The total cost of protecting the trees and plantings from insects during the year was $2,573.40.

The usual fire patrol service was maintained, and of a number of fires on water works lands only two resulted in any considerable damage, the others being extinguished in their infancy by our patrolmen or labor forces.

On May 17 a neighbor who was burning brush in Boylston, in a pasture adjoining water works land, lost control of the fire, which burned over $4\frac{3}{4}$ acres planted to white pine seedlings in 1918 and $2\frac{1}{2}$ acres planted to white pine seedlings in 1908, destroying 5,100 of the smaller trees and about 1,500 of the larger ones.

On December 25 sparks from a locomotive on the New York, New Haven & Hartford Railroad started a fire among the young pines on a lot in Marlborough, near the terminal chamber of the Wachusett Aqueduct, and burned over $5\frac{3}{4}$ acres of land planted in 1917, destroying about 5,200 white pine trees from 1 to 3 feet high.

The brush, grass and weeds were mowed and burned on about 2 miles of the marginal fire guard, which is 40 feet wide, and on 44 miles of forest road 15 to 45 feet wide. This mowing cost $42 per mile.

The work of clearing all brush and undergrowth and trimming trees within a marginal strip 100 feet in width along main highways bordering the water works land around the Wachusett Reservoir was continued in January and December. At the close of the year 83 acres along $5\frac{1}{4}$ miles of highway had been improved in this manner at a cost of $26.41 per acre. Railroad ties, fence posts and cordwood valued at $215 were obtained from this work, making the net cost $23.83 per acre.

During the construction of the Wachusett Reservoir samples of wood from 64 varieties of trees growing on the site of the reservoir were collected and carefully marked and preserved. These samples were presented to the Clinton Historical Society on May 16, and they will be kept and displayed at the society's rooms.

At the close of the year the Wachusett lands may be classified as follows: —

	Acres.
Forest lands acquired and not since improved,	1,394
Forest lands acquired and since improved,	338
Land which has been planted with trees and not since improved,	281
Land which has been planted with trees and since improved,	1,285
Land to be planted with trees,	608
Open land which will probably not be planted,	806
Marginal strip along shore of the reservoir,	212
Total,	4,924

The total expenditure for forestry on the Wachusett lands during 1920 amounts to $14,138.99.

Sudbury and Cochituate Lands.

At the Sudbury Reservoir nursery there were about 100,000 white pine seedlings at the beginning of the year, of which about 5,000 were later destroyed by the May beetle grub. Of the re-

mainder, 18,800 seedlings were set out to fill in failures in previous plantings; 6,250 were used to replace trees destroyed by fire; 17,700 were set out in new plantings at Pine Hill and other places where the land had been cleared; 4,000 were used at Whitehall Reservoir; and 500 were used on the islands in Framingham Reservoir No. 3. There were about 48,000 white pine seedlings four years old in the nursery at the end of the year.

Five and one-half acres of water works land at Pine Hill on the Taylor lot were cleared by the water works forces, and 4,500 chestnut fence posts 8 feet in length were obtained from this work, and about 10 acres of land were cleared by parties who bought birch wood.

At Sudbury Reservoir 22,500 gypsy moth egg masses were painted with creosote at a cost of $112.87. The trees on about 120 acres below Sudbury Dam, along highways and around the reservoir, were sprayed with arsenate of lead at a cost of $450.75. The new one-horse sprayer purchased early in the year proved to be very convenient and useful for work along the narrow roadways.

The tops of 17,400 pine trees were cut and burned to destroy the pine-tree weevil, at a cost of $450.33.

The apple trees and shrubbery below the Sudbury Dam were sprinkled with scalecide.

At Framingham Reservoirs Nos. 1, 2 and 3 the trees were sprayed with arsenate of lead, and at Hopkinton Reservoir, below the dam, the tops of 4,000 pine trees attacked by the weevil were cut and burned.

At Lake Cochituate and along the aqueducts $439.50 was expended in painting 64,000 gypsy moth egg masses with creosote, $21 in cutting and burning the tops of 2,000 pine trees attacked by weevils, and $645.60 in spraying trees with arsenate of lead.

From the nursery at Lake Cochituate 10,000 white pine seedlings four years old were transplanted to the Cochituate Aqueduct lands at Beethoven Avenue, Newton, at a cost of $199.

Very few brown-tail moth caterpillars were noticed during the year.

There were six fires on the Sudbury and Cochituate lands, five of them at Sudbury Reservoir and the other at Lake Cochituate. All but one of them were of unknown origin. Over 4,500 trees were destroyed valued at $725.

The total amount expended for forestry on the Sudbury and Cochituate lands was $9,794.44.

Distribution Reservoir Lands.

Gypsy and brown-tail moths and elm-leaf beetles were destroyed on distribution reservoir lands, as in former years, by spraying the foliage with arsenate of lead during the crawling season, and by painting the gypsy moth egg clusters with creosote and burning the brown-tail moth webs during the winter.

Oyster scale, found on shrubs at Chestnut Hill Reservoir, was destroyed by using scalecide and Arlington oil.

The leaders on pine trees at the Weston Reservoir, which were infested with the pine-tree weevil, were cut off and burned.

Underbrush and dead trees have been cut at various places in connection with the care of the wooded areas.

The total expenditure for all of the work on the distribution reservoir lands described above was $2,371.77.

The fine row of English elm trees along Beacon Street on the southerly side of the Chestnut Hill Reservoir, which were set out by the city of Boston water department in 1876, and are known as the Centennial elms, have begun to die, apparently from lack of nourishment due to construction of impervious street surface on one side and to the limited extent of good soil on the other. An attempt has been made to prolong the life of these trees by cutting out the dead wood and by placing additional soil enriched with manure just beyond the limits of the existing roots. This work was begun in November, and was in progress at the close of the year, the total expenditure to that time having been $1,700.

Hydro-electric Service.

The total quantity of electric energy delivered during the year from the two hydro-electric stations, which are operated with the power of the water drawn from the Wachusett and Sudbury reservoirs, is 16,192,191 kilowatt hours. The total value of the energy at contract prices, including rentals amounting to $139 for transmission line locations, is $91,282.92. The total expenses charged to both stations and transmission lines is $47,519.80, leaving a profit from the operation of the stations of $43,763.12, equivalent to $2.703 per thousand kilowatt hours. The total energy generated with water wasted and not used for water supply during the year was 3,973,908 kilowatt hours, which were sold for the sum of $21,679.66.

Wachusett Service.

The Wachusett power station was operated on 289 days during the year, and all energy not used in connection with the operation of the Metropolitan Water Works was sold to the New England Power Company and the Edison Electric Illuminating Company of Boston, under contract dated January 13, 1917.

According to the provisions of this contract the companies are required to maintain and operate the 66,000-volt transmission line constructed and owned by the Commonwealth, which extends for a distance of about 16 miles between the Wachusett and Sudbury power stations.

At the beginning of the year the New England Power Company had completed a connecting line from the Wachusett Dam to its substation in Clinton, and the Edison Electric Illuminating Company of Boston had completed a connecting line from the Sudbury Dam to its L Street power station in South Boston, and some of the preliminary tests necessary for putting the transmission lines in service had been completed. The new transmission lines were put into regular service January 19.

As a result of constructing the high-tension transmission line between the Wachusett and Sudbury power stations it has been possible to sell energy considerably in excess of what would otherwise have been possible.

By permission granted October 20, 1919, the New England Power Company made a connection with the Wachusett–Sudbury line near pole No. 277, about one-third of a mile below the upper dam on the open channel of the Wachusett Aqueduct, for a branch line to the substation of the Marlborough Electric Light Company. This connecting line was put into service March 2.

During the year the Edison Electric Illuminating Company of Boston constructed a branch line to its Framingham substation. For a distance of about 2,222 feet this branch line is located on Sudbury Aqueduct land under a permit granted December 24, 1919.

The transmission line owned by the Commonwealth has given satisfactory service and only minor repairs have been necessary, except in connection with an accident which occurred at pole No. 376, Southborough, on September 23, when the New England Power Company was demonstrating a method for replacing insulators with the line in service. As a result of this accident one of its linemen

was killed and another was seriously injured. The transmission line conductors were burned off and telephone cables at the Wachusett power station were burned out. The company replaced the latter with a new cable 1,600 feet in length, equipped with modern protective appliances, and repaired all damage to the transmission line.

About 8.40 A.M., May 3, while the head electrician and operator were attempting to correct a fault in the operation of the hydraulic governor on turbine No. 4, the electrician slipped and fell to the floor, and the governor was accidentally disconnected from the waterwheel. This allowed the wicket gates, which were nearly wide open, to close suddenly, and the resulting water ram broke out a large section of the top portion of the scroll case. The results were similar to those following the break in the case of turbine No. 2 from the same cause last year, which is fully described in the previous annual report. At the time of the accident exciter No. 1 and the four generating units were operating under full load. The electrician and operator were washed out of the station by the water. The helper left the station when the break occurred, and as it was impossible to enter the station and close the valves on the penstock because of the volume of water discharged from the break, it was necessary to shut off the water by closing the sluice gates in the dam, and the electric power not being available this had to be done by hand, but was completed twenty minutes after the accident occurred. As a result of the accident the automatic switches on both of the main feeders opened and the energy from generators Nos. 1, 2 and 3 flowed into generator No. 4, and the resulting short circuit burned out about one-third of the stator coils in that generator. Generators Nos. 1, 2 and 3 were only slightly damaged, but exciter No. 1 was damaged so that it was necessary to rewind the field and armature coils.

As in the case of the former break in 1919, repairs have been made by the Standardizing and Testing Department of the Edison Electric Illuminating Company of Boston, assisted by water works employees and the Lundin Electric and Machine Company of Boston. In connection with this work an employee of the latter company was accidentally electrocuted on May 25.

Units Nos. 1 and 2 were put into regular service again on May 24, unit No. 3 on May 28, and unit No. 4 had not been repaired at the close of the year.

Expenditures for the repair work completed at the close of the year amounted to $8,845.60.

Although the hydraulic governors had been overhauled and adjusted by the manufacturer in February they were not operating satisfactorily, and a short time before the accident occurred arrangements had been made and orders had been placed for changing them from the closed to the open system, but at the time of the accident the changes had not been made. As a result of further consideration it was deemed best to make changes in the old governors so that they could not be disconnected from the turbines, and use them temporarily until entirely new governing apparatus of the latest improved type shall have been installed. In connection with the changes which have been made in the old governors it was necessary to install an electric air compressor for charging the governor oil pressure tanks before starting a unit. Provision has been made in the estimates for 1921 for the new governing apparatus, and for replacing the broken top section of the scroll case of unit No. 4 with a new casting.

The nut by which the valve stem is attached to the wedge of the 48-inch hydraulic valve on the penstock line to unit No. 2 broke on July 7, and this unit was out of service thirteen days while repairs were being made.

The Wachusett hydro-electric statistics for the year 1920 are as follows: —

Total energy developed (kilowatt hours),	9,845,345
Energy used at power station (kilowatt hours),	35,985
Available energy (kilowatt hours),	9,809,360
Water used (gallons),	46,329,800,000
Average head (feet),	96.9
Energy developed per million foot gallons (kilowatt hours),	2.193
Efficiency of station (per cent),	69.8

Credits: —

Energy sold New England Power Company and Edison Electric Illuminating Company, 9,705,-162 kilowatt hours at $0.0053,	$51,437 36	
Deduction of 2 per cent as provided in contract, beginning April 1, 139,317 kilowatt hours at $0.0053,	738 38	
		$50,698 98

Credits — *Con.*			
Energy furnished Clinton sewerage pumping station, 104,198 kilowatt hours at $0.0053,		$552 25	
Rental, transmission line location,		139 00	
			$51,390 23
Charges: —			
Superintendence,		$1,377 12	
Labor, operating station,		10,275 86	
Repairs and supplies: —			
Power station,	$3,557 39		
Transmission line,	77 08		
		3,634 47	
		$15,287 45	
Taxes,		2,800 00	
Administration, general supervision, interest and sinking fund,		9,690 69	
			27,778 14
Profit,			$23,612 09
Cost of available energy per thousand kilowatt hours,			$2.832

Sudbury Service.

The Sudbury power station was operated on 305 days during the year, and on 157 of these days the station was operated two shifts of 8 hours each, and on the remaining 148 days was operated with three shifts of 8 hours each. It was not necessary to operate the station on a Sunday or holiday during the year.

The station was operated three shifts, at times, to maintain the water supply for the District, and at other times to utilize the waste water for the generation of electric energy, and on this account the wheels were operated much of the time at maximum capacity rather than at maximum efficiency, and the average efficiency for the year is slightly less than for 1919, but the output is about 20 per cent greater.

All the water drawn from the Sudbury Reservoir was used to generate electricity. Some water not needed at Weston Reservoir for the supply of the District was passed through turbines Nos. 1 and 2 into the Weston Aqueduct head house, and turned back through the No. 3 60-inch pipe line and discharged through the 24-inch gates into the open channel to Framingham Reservoir No. 3. A total of 4,163,800,000 gallons was diverted in this manner, from

which 370,750 kilowatt hours of energy were obtained and sold for $2,317.19. A total of 3,145,100,000 gallons of water not needed for water supply was passed through turbine No. 3 into the open channel and Framingham Reservoir No. 3, from which 474,489 kilowatt hours of energy were obtained which were sold for $2,965.56.

Inspections were made several times during the year of the wheel pits and the portions of the machinery located below the power station floor. On November 4 a water-soaked pine log 6½ feet in length and about 6 inches in diameter was found wedged in the wicket gate links of unit No. 3, which was removed with considerable difficulty. It had forced the shaft against one side of the steady bearings and caused considerable wear on the lignum-vitæ blocks and a noticeable thumping of the generator which ceased when the steady bearings were adjusted.

Brush and weeds were cut and burned twice during the year on the portion of the 13,800-volt transmission line to Hopkinton owned by the Commonwealth, which extends for a distance of 4,000 feet from the Sudbury Dam to Brewer Road.

On February 7 energy was first delivered from the Sudbury power station to the Wachusett–Sudbury transmission line, and since that date both the Hopkinton and Wachusett–Sudbury lines have been available for the transmission of electric energy developed at the Sudbury power station.

The Sudbury hydro-electric statistics for the year 1920 are as follows: —

Total energy developed (kilowatt hours),	6,393,390
Energy used at power station (kilowatt hours),	10,559
Available energy (kilowatt hours),	6,382,831
Framingham Reservoir No. 3 service: —	
Water used (gallons),	30,353,000,000
Average head (feet),	64.77
Weston Aqueduct service: —	
Water used (gallons),	20,255,500,000
Average head (feet),	37.49
Energy developed per million foot gallons (kilowatt hours),	2.346
Efficiency of station (per cent),	74.7
Credits: —	
Energy sold Edison Electric Illuminating Company of Boston, 6,382,831 kilowatt hours at $0.00625,	$39,892 69

Charges: —			
Superintendence,		$1,494 50	
Labor, operating station,		10,723 03	
Repairs and supplies,		718 01	
Alterations and additions: —			
Labor,	$31 50		
Apparatus and supplies,	23 65		
		55 15	
		$12,990 69	
Taxes,		1,463 20	
Administration, general supervision, interest and sinking fund,		5,287 77	
			$19,741 66
Profit,			$20,151 03
Cost of available energy per thousand kilowatt hours,			3.093

Distribution Pumping Service.

The total quantity of water pumped at the five distribution pumping stations during the year was 32,644,780,000 gallons, and 3,251,300,000 gallons, or 11.06 per cent, more than the quantity pumped in 1919. Of the total quantity of water supplied to the Metropolitan Water District in 1920, about 69.5 per cent was pumped for the northern low, high and extra high services and the southern low service, and 0.59 per cent was repumped for the southern extra high service.

The total cost of operating all the pumping stations for the year 1920 is $250,117.86. Compared with the previous year there is an increase of about $15,000 for operating labor, due to increased wages, an increase of about $11,200 for repairs and an increase of about $25,600 for fuel, making a total increase for these items of about $51,800; but as there was a saving of about $400 in the cost of supplies the net increase for the year is about $51,400.

Fuel.

At the beginning of the year there were 1,100 gross tons of bituminous coal and 1,500 gross tons of anthracite screenings on hand at the pumping stations. During the year 8,597 gross tons of bituminous coal and 3,368 gross tons of anthracite screenings were

purchased. At the close of the year there were 2,270 gross tons of bituminous coal and 1,630 gross tons of anthracite screenings on hand at the pumping stations.

During the early part of the year 810 gross tons of bituminous coal were received from the George E. Warren Company under a contract made in 1919 at a price of $3.09 per gross ton at the mines for coal of specified quality, with a specified variation in price for variation in quality. Early in February, owing to an increase in miners' wages, the company increased the price to $3.10 per net ton, equivalent to $3.47 per gross ton at mines, regardless of quality, and 827 gross tons were purchased on this basis. Later, in April, the company again increased the price to $5 per net ton, or $5.60 per gross ton at the mines, and further purchase of coal from the company was stopped. As 158 tons had already been shipped from the mines at the new price it was accepted.

The remainder of the bituminous coal for operating the pumping stations was purchased from time to time from various dealers who were able to secure transportation or to load cars assigned for our service. A saving of about $4 per net ton was made on all coal purchased for shipment in assigned cars.

On account of the high price of bituminous coal considerable economy has resulted from burning a mixed fuel containing about one-third anthracite screenings and two-thirds bituminous coal. For this purpose 1,153 gross tons of anthracite screenings were purchased from the New England Fuel and Supply Company, and 2,215 gross tons of anthracite screenings have been obtained from local coal yards.

On August 26, 1920, a new freight tariff went into effect which increased the cost of bituminous coal about $1.50 and the cost of anthracite screenings about $1.20 per gross ton.

During the year the cost per net ton of fuel delivered at the pumping stations has varied from $5.70 to $18.08 for bituminous coal, and from $4 to $7.46 for anthracite screenings.

The amount and cost of coal received at the pumping stations during 1920 was as follows: —

Dealer and Kind of Coal.	Stations (Amount in Gross Tons).						Average Cost in Bins.[5]	
	Chestnut Hill Storage Pile.[1]	Chestnut Hill Station No. 1.[2]	Chestnut Hill Station No. 2.[3]	Spot Pond Station.[4]	Arlington Station.[3]	Hyde Park Station.[3]	Gross Ton.	Net Ton.
Bituminous.								
E. Russell Norton,	365.04	–	–	–	–	–	13.95[1]	12.46[1]
George E. Warren Co.,	–	361.61	–	–	–	–	7.00	6.25
E. Russell Norton,	–	936.56	–	–	–	–	13.04	11.64
New England Fuel & Supply Co.,	–	95.63	–	–	–	–	11.55	10.31
George E. Warren Co.,	–	–	1,243.24	–	–	–	6.98	6.23
E. Russell Norton,	–	–	2,532.63	–	–	–	13.13	11.72
Potts Run Coal Sales Corp.,	–	–	780.94	–	–	–	8.87	7.92
New England Coal & Coke Co.,	–	–	291.83	–	–	–	10.51	9.38
New England Fuel & Supply Co.,	–	–	238.62	–	–	–	11.74	10.48
Thomas Joseph McCue,	–	–	111.70	–	–	–	17.86	15.95
George E. Warren Co.,	–	–	–	97.11	–	–	8.19	7.31
Thomas Joseph McCue,	–	–	–	663.24	–	–	16.35	14.60
Potts Run Coal Sales Corp.,	–	–	–	193.95	–	–	10.17	9.08
New England Coal & Coke Co.,	–	–	–	155.60	–	–	14.31	12.78
New England Fuel & Supply Co.,	–	–	–	48.10	–	–	13.73	12.26
Spring Coal Co.,	–	–	–	39.22	–	–	8.85	7.90
Locke Coal Co.,	–	–	–	31.60[6]	–	–	13.12	11.71
George E. Warren Co.,	–	–	–	–	45.31	–	7.35	6.56
E. Russell Norton,	–	–	–	–	83.80	–	12.15	10.85
New England Coal & Coke Co.,	–	–	–	–	105.89	–	14.87	13.28
Thomas Joseph McCue,	–	–	–	–	68.75	–	13.87	12.38
George E. Warren Co.,	–	–	–	–	–	47.46	7.42	6.63
Potts Run Coal Sales Corp.,	–	–	–	–	–	48.88	9.58	8.56
Roxbury Coal Co.,	–	–	–	–	–	10.29[6]	12.32	11.00
Totals (8,597.00 tons),	365.04	1,393.80	5,198.96	1,228.82	303.75	106.63	–	–
Average Cost: —								
In bins (gross ton),	13.95[1]	11.37	10.91	14.04	12.77	8.88	–	–
In bins (net ton),	12.46[1]	10.15	9.74	12.54	11.40	7.93	–	–
On cars or trucks (gross ton),	13.62	10.70	10.68	12.93	12.59	8.39	–	–
On cars or trucks (net ton),	12.16	9.55	9.54	11.55	11.24	7.49	–	–
Anthracite Screenings.								
Metropolitan Coal Co.,	352.45[6]	–	–	–	–	–	5.07[1]	4.53[1]
Batchelder Bros.,	171.36[6]	–	–	–	–	–	5.75[1]	5.13[1]
New England Fuel & Supply Co.,	75.00	–	–	–	–	–	7.46[1]	6.66[1]
New England Fuel & Supply Co.,	–	274.64	–	–	–	–	7.74	6.91
Metropolitan Coal Co.,	–	52.31[6]	–	–	–	–	6.18	5.52
Brighton Coal Co.,	–	78.12[6]	–	–	–	–	7.35	6.56
John A. Whittemore's Sons,	–	46.79[6]	–	–	–	–	5.86	5.23
New England Fuel & Supply Co.,	–	–	701.88	–	–	–	6.76	6.04
Metropolitan Coal Co.,	–	–	343.35[6]	–	–	–	6.44	5.75
Brighton Coal Co.,	–	–	56.93[6]	–	–	–	6.90	6.16
Locke Coal Co.,	–	–	–	610.83[6]	–	–	7.03	6.28
Wilbur W. Fiske & Co.,	–	–	–	1.84[6]	–	–	5.04	4.50
Metropolitan Coal Co.,	–	–	–	–	244.43[6]	–	6.67	5.95
New England Fuel & Supply Co.,	–	–	–	–	101.70	–	7.68	6.86
Wm. H. Harlow & Sons,	–	–	–	–	–	137.95[6]	5.60	5.00
Batchelder Bros.,	–	–	–	–	–	71.12[6]	5.60	5.00
Roxbury Coal Co.,	–	–	–	–	–	47.36[6]	5.60	5.00
Totals (3,368.06 tons),	598.81	451.86	1,102.16	612.67	346.13	256.43	–	–
Average cost: —								
In bins (gross ton),	5.56[1]	7.30	6.67	7.02	6.96	5.60	–	–
In bins (net ton),	4.96[1]	6.52	5.96	6.27	6.21	5.00	–	–
On cars or trucks (gross ton),	5.24	5.83	6.11	6.07	6.56	–	–	–
On cars or trucks (net ton),	4.68	5.21	5.46	5.42	5.86	–	–	–

[1] Unloaded in storage pile, later to be transported 300 feet and put into bins.

[2] Hoisted from cars and wheeled to bins.

[3] Dumped from cars into bins.

[4] Unloaded at freight yard, teamed 1½ miles, and dumped into bins.

[5] Includes cost of unloading coal from cars and all expenses incidental to the mixing and storage of the coal.

[6] Delivered at station by truck.

All coal received during the year was sampled and analyzed and the results are as follows: —

Kind of Coal.	Number of Samples tested.	Percentage of Moisture in Coal as received.	Dry Basis.			
			Percentage of Volatile Matter.	Percentage of Fixed Carbon.	Percentage of Ash.	British Thermal Units.
Nanty Glo,	23	4.77	19.11	74.07	6.82	14,729
Clearfield District,	20	4.09	23.66	62.83	13.51	13,693
Davenport,	15	3.06	19.80	70.31	9.89	14,252
South Fork,	18	2.68	17.32	72.80	9.88	14,192
Miscellaneous,	15	4.25	20.40	70.79	8.81	14,385
Pool-10,	4	2.78	15.85	68.82	15.33	13,350
Pool-71,	4	2.41	15.19	73.42	11.39	13,973
Melba-3,	4	1.89	21.90	66.83	11.27	14,019
Melba-1,	3	3.66	23.11	69.77	7.12	14,656
Barnet,	1	3.18	17.47	70.65	11.88	13,864
Anthracite screenings,	50	6.27	5.13	78.62	16.25	12,341

Chestnut Hill Pumping Stations.

Horizontal return tubular boilers Nos. 1, 2 and 3 were stripped of all useful trimmings and connecting flues and pipes in preparation for disposing of them and the brick settings to provide space for the two new 98-inch diameter vertical fire tube boilers which are being built for the station in connection with the installation of the new pumping engine No. 16, which will replace engine No. 2, but will have a capacity of 15,000,000 gallons per day, or nearly double that of the old engine.

A small steam pump and a sump tank of 104 gallons capacity have been installed, and the pipe connections with the three hydraulic valves on the southern high-service pipe lines outside of the pumping station have been rearranged so that the valves can be operated by using cold test oil instead of water, and the trouble from freezing of the water will be avoided.

At Chestnut Hill pumping station No. 2 new grates of the Perfection shaking and dumping type were installed in boilers Nos. 6 and 16, and seven new tubes were installed in boiler No. 16 and one tube in boiler No. 7. The lower ends of the tubes in boilers Nos. 15 and 16 were electro-welded to the lower tube sheet to prevent leakage caused from expansion and contraction when the boil-

ers are put into or taken out of service. A few small fire cracks on edges of plates and in rivets were also welded.

Old stay bolts to the number of 390 in boiler No. 15 and 29 in boiler No. 16 were replaced with Tate flexible stay bolts which are designed to allow movements due to changes in temperature to take place without breaking.

The installation of the independent rotrex air pump, purchased in 1919, has been completed, and a noticeable increase in efficiency of the low-service engines results from its use, especially when these engines are operated at low speed. The rotrex pump is also a great convenience when starting the engines.

As the meter on the low-service boiler feed water line required constant repairs, it was replaced in December by a 2 inch x $\frac{3}{4}$ inch improved Type M Venturi meter. The boiler feed water piping was rearranged and renewed, and air chambers were placed on both the high and low-service boiler feed water lines to prevent water ram, with satisfactory results.

The track for the ash cars was relaid for a distance of 80 feet, starting at the elevator which raises the ash cars from the tunnel under the boilers to the surface of the ground outside the station. A spur track 30 feet in length for the temporary storage of cars was also laid, and as a result of these changes all of the ashes for the entire twenty-four hours are now removed by daylight during the first watch by using the additional ash cars purchased last year.

At the suggestion of the engine builder, Jenkins No. 94 rubber pump valves $\frac{5}{8}$ of an inch thick without cover plates were installed in the high-pressure pump chambers of engine No. 12, on December 29, in place of the old valves which were $\frac{3}{4}$ of an inch thick and were provided with brass cover plates $\frac{1}{8}$ of an inch thick. A noticeable improvement in the operation of the engine has resulted from this change. It is planned to make a similar change in the intermediate and low-pressure pump valves later if the preliminary trial of the new valves continues satisfactory.

At theses stations 28,768,082,000 gallons of water were pumped during the year, of which 15,675,759,000 gallons were supplied to the southern high-service district and the southern extra high-service pumping station, and the remainder, 13,092,323,000 gallons, was supplied to the southern low-service district. The average daily pumpage was 42,830,000 gallons for the high service and

35,771,000 gallons for the low service, with a maximum of 54,847,000 gallons on January 26 for the high service, and 58,017,000 gallons on January 5 for the low service.

The pumping statistics for these stations for 1920 are as follows: —

Station No. 1.

Pumpage and Duty.

	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Totals.
Pumping capacity (million gallons per day),	16	20	30	66
Pumping time (engine hours),	4,288.17	10.42	427.33	4,725.92
Pumpage, total (million gallons),[1]	1,375.51	8.52	430.06	1,814.09
Pumpage, average daily (gallons),[1]	3,758,200	23,200	1,175,100	4,956,500
Lift, average (feet),	132.55	126.05	128.34	131.52
Coal used: —				
Bituminous (pounds),	–	–	–	2,788,907
Anthracite screenings (pounds),	–	–	–	1,025,804
Duty, average (foot pounds per 100 pounds coal),	–	–	–	52,100,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence),	$19,584 03	$10 80	8.21	2.61
Fuel,	14,072 92	7 76	5.90	1.88
Repairs,	9,232 45	5 09	3.87	1.23
Oil, waste and packing,	746 02	41	.31	.10
Miscellaneous supplies,	859 78	47	.36	.12
Totals,	$44,495 20	$24 53	18.65	5.94
Administration, general supervision, interest and sinking fund.	33,233 59	18 32	13.93	4.44

Station No. 2.

Pumpage and Duty.

	Engines Nos. 5, 6 and 7.	Engine No. 12.	Totals.
Pumping capacity (million gallons per day),	105	40	145
Pumping time (engine hours),	12,698.33	8,741.25	21,439.58
Pumpage, total (million gallons),[1]	13,092.32	13,861.67	26,953.99
Pumpage, average daily (gallons),[1]	35,771,400	37,873,400	73,644,800
Lift, average (feet),	29.82	123.22	77.85
Coal used: —			
Bituminous (pounds),	–	–	10,628,323
Anthracite screenings (pounds),	–	–	3,968,740
Duty, average (foot pounds per 100 pounds coal),	–	–	119,750,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence),	$49,124 77	$1 82	2.34	.74
Fuel,	59,927 18	2 22	2.86	.91
Repairs,	25,128 64	93	1.19	.38
Oil, waste and packing,	1,656 62	06	.08	.03
Miscellaneous supplies,	1,174 87	05	.06	.02
Totals,	$137,012 08	$5 08	6.53	2.08
Administration, general supervision, interest and sinking fund.	37,175 84	1 38	1.77	.56

As the boilers have been operated in one battery most of the time, the duties of the individual engines at these stations were not determined.

Spot Pond Pumping Station.

The Green fuel economizer at the Spot Pond pumping station, which had been in service for twenty years, was renewed at a cost of $4,184.12. This work was completed and the new economizer put into service on September 23.

Guard railing has been erected around the top of the low-pressure cylinder of engine No. 9 to protect the employees from accidentally falling and receiving injuries.

All of the water supplied to the northern high-service district was pumped at this station. The pumps were operated about 11 hours per day, the boilers being maintained with banked fires when not in use.

The northern high-service pumping statistics for 1920 are as follows: —

Spot Pond Station.

Pumpage and Duty.

	Engine No. 8.	Engine No. 9.	Totals.
Pumping capacity (million gallons per day),	10	20	30
Pumping time (engine hours),	134.50	3,785.25	3,919.75
Pumpage, total (million gallons),[1]	58.24	3,228.34	3,286.58
Pumpage, average daily (gallons),[1]	159,100	8,820,600	8,979,700
Lift, average (feet),	122.62	134.86	134.64
Coal used: —			
Bituminous (pounds),	38,165	2,222,970	2,261,135
Anthracite screenings (pounds),	24,760	1,317,337	1,342,097
Duty, average (foot pounds per 100 pounds coal),	94,550,000	102,440,000	102,300,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence),	$15,580 85	$4 74	3.52	1.12
Fuel,	16,302 11	4 96	3.68	1.17
Repairs,	5,837 66	1 78	1.32	.42
Oil, waste and packing,	701 99	21	.16	.05
Miscellaneous supplies,	556 45	17	.13	.04
Totals,	$38,979 06	$11 86	8.81	2.80
Administration, general supervision, interest and sinking fund.	17,278 73	5 26	3.90	1.24

Arlington Pumping Station.

All the water supplied to the northern extra high-service district during the year was pumped at the Arlington pumping station from the northern low-service mains. Only minor repairs have been necessary at this station during the year.

The northern extra high-service pumping statistics for 1920 are as follows: —

Arlington Station.

Pumpage and Duty.

	Engine No. 10.	Engine No. 11.	Engine No. 15.	Totals.
Pumping capacity (million gallons per day),	1.5	1.5	3.0	6
Pumping time (engine hours),	7,344.25	–	55.00	7,399.25
Pumpage, total (million gallons),[1]	312.89	–	3.58	316.47
Pumpage, average daily (gallons),[1]	854,900	–	9,800	864,700
Lift, average (feet),	283.75	–	290.03	283.82
Coal used: —				
Bituminous (pounds),	604,427	–	10,948	615,375
Anthracite screenings (pounds),	686,172	–	7,678	693,850
Duty, average (foot pounds per 100 pounds coal),	57,300,000	–	46,510,000	57,150,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence),	$10,837 76	$34 24	12.07	3.84
Fuel,	4,977 55	15 73	5.54	1.77
Repairs,	1,046 90	3 31	1.17	.37
Oil, waste and packing,	201 51	64	.22	.07
Miscellaneous supplies,	360 97	1 14	.40	.13
Totals,	$17,424 69	$55 06	19.40	6.18
Administration, general supervision, interest and sinking fund.	6,024 23	19 04	6.71	2.14

Hyde Park Pumping Station.

All of the water supplied to the southern extra high-service district was repumped at the Hyde Park pumping station from the southern high-service mains. The pumps were operated about 12 hours per day, the boilers being maintained with banked fires when not in use.

The southern extra high-service pumping statistics for 1920 are as follows: —

Hyde Park Station.

Pumpage and Duty.

	Engine No. 13.	Engine No. 14.	Totals.
Pumping capacity (million gallons per day),	3	3	6
Pumping time (engine hours),	3,373.67	1,102.91	4,476.58
Pumpage, total (million gallons),[1]	206.07	67.58	273.65
Pumpage, average daily (gallons),[1]	563,000	184,700	747,700
Lift, average (feet),	139.81	138.99	139.60
Coal used: —			
Bituminous (pounds),	202,750	67,829	270,579
Anthracite screenings (pounds),	338,696	109,584	448,280
Duty, average (foot pounds per 100 pounds coal),	44,320,000	44,100,000	44,270,000

[1] Corrected for slip.

Cost of Pumping.

	Totals.	Per Million Gallons.	Per Million Foot Gallons.	Electric Equivalent per Kilowatt Hour.
			Cents.	Cents.
Labor (operation and superintendence),	$8,814 76	$32 21	23.07	7.35
Fuel,	1,845 47	6 74	4.83	1.54
Repairs,	906 80	3 32	2.37	.75
Oil, waste and packing,	285 39	1 04	.75	.24
Miscellaneous supplies,	354 41	1 30	.93	.30
Totals,	$12,206 83	$44 61	33.95	10.18
Administration, general supervision, interest and sinking fund.	5,034 21	18 40	13.18	4.20

Distribution Reservoirs.

The locations, elevations and capacities of the distribution reservoirs of the Metropolitan Water Works are shown by the following table: —

Distribution Reservoirs and Locations.	Elevation of High Water.[1]	Capacity in Gallons.
Low Service: —		
Spot Pond, Stoneham and Medford,	163.00	1,791,700,000
Chestnut Hill Reservoir, Brighton district of Boston,	134.00	300,000,000
Weston Reservoir, Weston,	200.00	200,000,000
Mystic Reservoir, Medford,	157.00	26,200,000
Northern High Service: —		
Fells Reservoir, Stoneham,	271.00	41,400,000
Bear Hill Reservoir, Stoneham,	300.00	2,450,000
Northern Extra High Service: —		
Arlington Standpipe, Arlington,	442.00	550,000
Southern High Service: —		
Fisher Hill Reservoir, Brookline,	251.00	15,500,000
Waban Hill Reservoir, Newton,	264.50	13,500,000
Forbes Hill Reservoir, Quincy,	192.00	5,100,000
Forbes Hill Standpipe, Quincy,	251.00	330,000
Southern Extra High Service: —		
Bellevue Reservoir steel tank, West Roxbury district of Boston,	375.00	2,500,000
Total,	–	2,399,230,000

[1] Elevation in feet above Boston city base.

By arrangement with the city of Chelsea a portion of the maintenance of its reservoir on Powder Horn Hill is assumed by the Metropolitan Water Works, and the reservoir is used when necessary in connection with the northern high-service supply. The reservoir has a capacity of 1,000,000 gallons with high-water line at elevation 196.6. The reservoir was in service from January 1 to April 21, and during the remainder of the year was kept full of water for use in case of emergency. No leakage has been noticed from the reservoir since the masonry lining was repaired in 1919.

By arrangement with the city of Malden the maintenance of its standpipe on Waitt's Mount, which the city planned to discontinue and dispose of, was assumed by the Division in June, and after

minor repairs had been made was filled with water on August 5, and thereafter was kept full of water for use in case of emergency. The standpipe has a storage capacity of 1,120,000 gallons when filled to high-water line at elevation 250.

Weston Reservoir.

All the ironwork was painted in the channel chamber at the inlet to the Weston Reservoir, the screen chamber at the outlet of the reservoir and the terminal chamber of the lower Weston Aqueduct. The iron fences at Ash Street bridge and at the terminal chamber, and the stop planks in the screen chamber, were also painted. A new set of screens and a screen elevator were installed at the terminal chamber. About 2,000 feet of wire fence was rebuilt, and the riprap, beaches, lawns, walks, drives and drains about the reservoir were kept in good order.

Chestnut Hill, Fisher Hill and Waban Hill Reservoirs.

The gatehouses, screens and grounds at the Chestnut Hill, Fisher Hill and Waban Hill reservoirs were given the necessary attention, and all the ironwork in the gatehouses was painted.

At Chestnut Hill Reservoir the Bradlee Basin was in service throughout the year, and the Lawrence Basin was in service except from December 28 to 31, inclusive.

The policing of the grounds was transferred to the Park Division in May. The cost of this work for the remainder of the year amounted to $2,140.61, and was paid by the Water Division.

Spot Pond, Fells and Bear Hill Reservoirs.

The gatehouses, screens, grounds and fences at Spot Pond and the Fells and Bear Hill reservoirs were kept in good condition. The woodwork on the exterior and the ironwork in the interior of all the gatehouses were painted. New screens were made for the east gatehouse at Spot Pond and for the gatehouse at Fells Reservoir. The roof gutters on the east gatehouse at Spot Pond were rebuilt and lined with sheet lead as the old gutters did not drain properly.

The policing of the grounds at these reservoirs was transferred to the Park Division in May, but the cost of the work for the remainder of the year, amounting to $586.24, was paid by the Water Division.

Bellevue and Forbes Hill Reservoirs.

All the ironwork connected with the masonry tower at Bellevue Reservoir was painted, the windows were repaired, and snow and ice were removed from the roof during the winter.

Forbes Hill Reservoir was kept full of water for emergency use. The three lower courses of the standpipe and the iron stairs and woodwork of the tower were painted. A new fence enclosing the grounds was completed.

Arlington and Mystic Reservoirs.

Some minor repairs were made to doors and stairway at the Arlington standpipe and to the gatehouse and the concrete walk at the Mystic Reservoir. The latter reservoir was in service from January 1 to July 14, and for the remainder of the year was kept full of water for emergency use.

Mystic Lake, Conduit and Pumping Station.

The old Mystic water works structures although not in use were given such attention as necessary to keep them in repair. At the lake the gatehouse was repaired and woodwork painted. The floor of the bridge over the wasteway was relaid and reinforced and the elevation of the water in the lake was regulated.

The old pumping station was occupied by the American Radio and Research Corporation until July 1. Since that time alterations have been made in preparing it for use as a garage, carpenter shop, paint shop and storehouse. The easterly portion, covering about 2,000 square feet, was transferred to the Park Division for storage and other purposes. The brick chimney, 100 feet in height, which was in poor condition and dangerous, was razed September 1, and about 80,000 bricks were salvaged and cleaned for future use by contract at a cost of $1,365.31.

The stalls in the stable which are no longer used were removed and the floor relaid on new timbers. The coping of the French roof and the window frames in the roof were repaired and all of the sashes were replaced.

Grounds at Arlington and Hyde Park Pumping Stations.

The lawns, shrubs and fences at the Arlington and Hyde Park pumping stations were cared for and at the Hyde Park pumping station the boiler blow-off drain, which had become clogged, was dug up and relaid.

Distribution Pipe Lines.

The length of the distribution pipe lines owned and operated at the close of the year is 126.13 miles, an increase of 0.05 miles during the year.

The pipe lines were patrolled except during the winter when the trucks could not be used on account of deep snow.

Inspections were made of the work of municipalities and public service corporations in the vicinity of the pipe lines and gate covers were regulated where necessary in connection with the resurfacing of streets.

Salt was placed over the covers of important valves during the cold weather to keep them free from ice.

In September the work of cleaning, oiling and repairing pipe line valves, which had been considerably neglected during the last few years on account of scarcity of labor, was resumed and is now receiving the necessary attention.

Low-service Mains.

The 12-inch Venturi meter and register on the connection between the Metropolitan Water Works low-service main in Broadway at Marshall Street in Somerville and the local 12-inch main were removed on August 18 and replaced with straight pipe.

A $1\frac{1}{2}$-inch disc meter was installed on the service pipe through which two houses are supplied from the 30-inch low-service main in Lawrence Road in Somerville.

Northern High-service Mains.

During the cold weather the water froze in the pressure cylinder of the hydraulic valve outside the pumping station at Spot Pond, on the northern high-service force main from engine No. 9, and cracked the cylinder, and while replacing with a new cylinder on October 14, it was found that the valve stem was also broken at

the nut where it is fastened to the wedge. On November 7 the broken valve stem was replaced with a new stem made of Monel metal.

The unmetered emergency connection between the northern high-service main in Beach Street at Pleasant Street, Revere, was equipped with a 12-inch Venturi meter and 12-inch Ross pressure regulator, and the connection was opened for regular use on November 19. As the city receives increased pressure and better fire protection service from this connection it has paid the entire cost of the installation, which remains the property of the Division.

On account of excavations for sewers in Market and Broad streets in Lynn, below the northern high-service 16-inch main, it was necessary to suspend the main in slings with adjustable screws which were left in place for some time after the trench was refilled to prevent settlement of the main.

Southern High-service Mains.

A 16-inch emergency connection was made on June 24 in Lake Street near Commonwealth Avenue in Brighton, between the 20-inch southern high-service main laid in 1918 to Watertown and the 12-inch city of Boston main in Commonwealth Avenue.

The 6-inch blow-off line from the first 20-inch main laid to Watertown in 1897 was relocated in connection with the construction by the Park Division of a boulevard along the south shore of the Charles River near St. James Avenue in Newton.

Screw-operated 36-inch gate valve No. 43, in Reservoir Lane at the southwest corner of Chestnut Hill pumping station No. 1, was changed to hydraulic operation on September 19 and the pressure pipes for use in operating both this valve and hydraulic valves Nos. 45 and 97 on the southern high-service force mains at this place were connected with a steam-operated pump in the station so that they can be operated with oil instead of with water, which has given trouble from freezing in winter.

Southern Extra High-service Pipe Lines.

In connection with the work of widening Hyde Park Avenue in Boston it was necessary to relay the 6-inch blow-off line near Winthrop Street and adjust covers of valve chambers to the new grade.

Pipe Bridges.

Minor repairs were made to pipe bridges at Broadway, Chelsea, over the Mystic River, and Walnut Street, Somerville, over the Boston & Maine Railroad, and extensive repairs were made at the pipe bridges over the Boston & Maine Railroad at Massachusetts Avenue in Cambridge at an expense of $400, and at College Avenue, Medford, at an expense of $2,085.86, in connection with repairs to the highway bridges by the railroad company.

Pipe Yards.

No changes have been made at the Chestnut Hill pipe yard and only a few minor repairs have been necessary to keep the buildings in good condition.

At the Glenwood pipe yard the hot-water heating system has been replaced by steam. Minor repairs were made on the interior of the building and the exterior brickwork was repointed. The spur track has been relaid, using all new ties to the number of 229, which were obtained from water works lands in the Wachusett Section.

Meters, Regulating Valves and Recording Pressure Gages.

There are now 69 Venturi meters varying in size from 6 to 60 inches in diameter connected with the supply and distribution mains. Of this number, 62 are on the connections supplying the various cities and towns in the Water District. In addition to the Venturi meters there are 4 disc meters, 1 torrent meter and 7 detector meters used in measuring water supplied to various municipalities, and 1 disc meter and 1 detector meter used for measuring water supplied to the Park Division from the northern high-service mains in the Middlesex Fells. There are also 3 Union meters and 1 Crown meter belonging to the town of Milton, which are used in measuring water supplied from the southern extra high service, and 1 detector meter owned by the city of Malden, which is used for measuring water supplied through the fire line at Commercial and Pleasant streets.

Three men and a light auto truck are now used in the operation and care of the meters. They are visited regularly twice each week and are also given such additional attention as is necessary to keep them in repair and operating satisfactorily. On account of the extreme cold weather during the winter months it was necessary

to maintain heat in some of the register chambers to prevent the water from freezing in the pressure pipes.

The nine pressure regulating valves installed in the distribution mains for reducing the pressure of water supplied to portions of Chelsea, East Boston and Hyde Park, and to Nahant, Revere, Swampscott and Winthrop, have received the usual attention and have controlled the water pressures in a satisfactory manner.

Recording pressure gages have been maintained at twenty stations on the distribution system, and the table in Appendix No. 2, showing the elevation of the hydraulic grade line at eighteen of these stations, has been prepared from the charts.

Breaks and Leaks.

About 10 A.M. April 17, a break occurred in the 48-inch low-service main in Clinton Road near Dean Road, Brookline, which flooded four cellars and washed out several lawns and shrubbery beds. As it was not necessary to complete the repairs promptly the line was not put in service again until June 4. The cost of repairing the damage done was $1,334.96, of which $602.26 was for damage to private property and $732.70 for repairing the pipe line and street.

There were 49 minor leaks in mains during the year which were repaired at a cost of $2,423.96. Of these leaks 9 were from defective wooden joints and were repaired at a cost of $681.17. Of the remainder, 35 were at lead joints, 2 on kalomine pipe and 1 on account of perforations of a 12-inch main by electrolysis, and 2 were on $\frac{3}{4}$-inch pressure pipes to recording gage and Venturi meter register.

Emergency Pipe Line Service.

The two $\frac{3}{4}$-ton auto trucks, equipped with special bodies and gate-operating attachments, put into service in 1917 for operating valves quickly in case of emergency, have been in service during the entire year. One of the trucks is stationed at the Chestnut Hill pipe yard in Brighton for use on the southern portion of the distribution pipe system, and the other is stationed at the Glenwood pipe yard in Medford for use on the northern portion of the pipe system. Men are kept on duty ready to operate the trucks in case of emergency at any time during the day or night.

Consumption of Water.

During the year 46,579,167,000 gallons of water were furnished to the 18 municipalities in the Metropolitan Water District supplied from the Metropolitan Water Works. This is equivalent to an average daily consumption of 127,265,500 gallons, which, for the estimated population of 1,213,430, based on the 1920 census, is at the rate of 105 gallons per capita per day and comparable with a rate of 100 gallons per capita per day in 1919. The increase in per capita consumption is probably due largely to the severe winter and resulting waste of water to prevent freezing of service pipes.

Now that the war is over and conditions are returning to normal, there appears to be no reason why thorough inspections by local officials and the unrestricted enforcement of the legislation of 1907, for the installation of meters on service pipes, should not reduce the per capita consumption of water to 90 gallons per day, which was sufficient for all purposes in 1915.

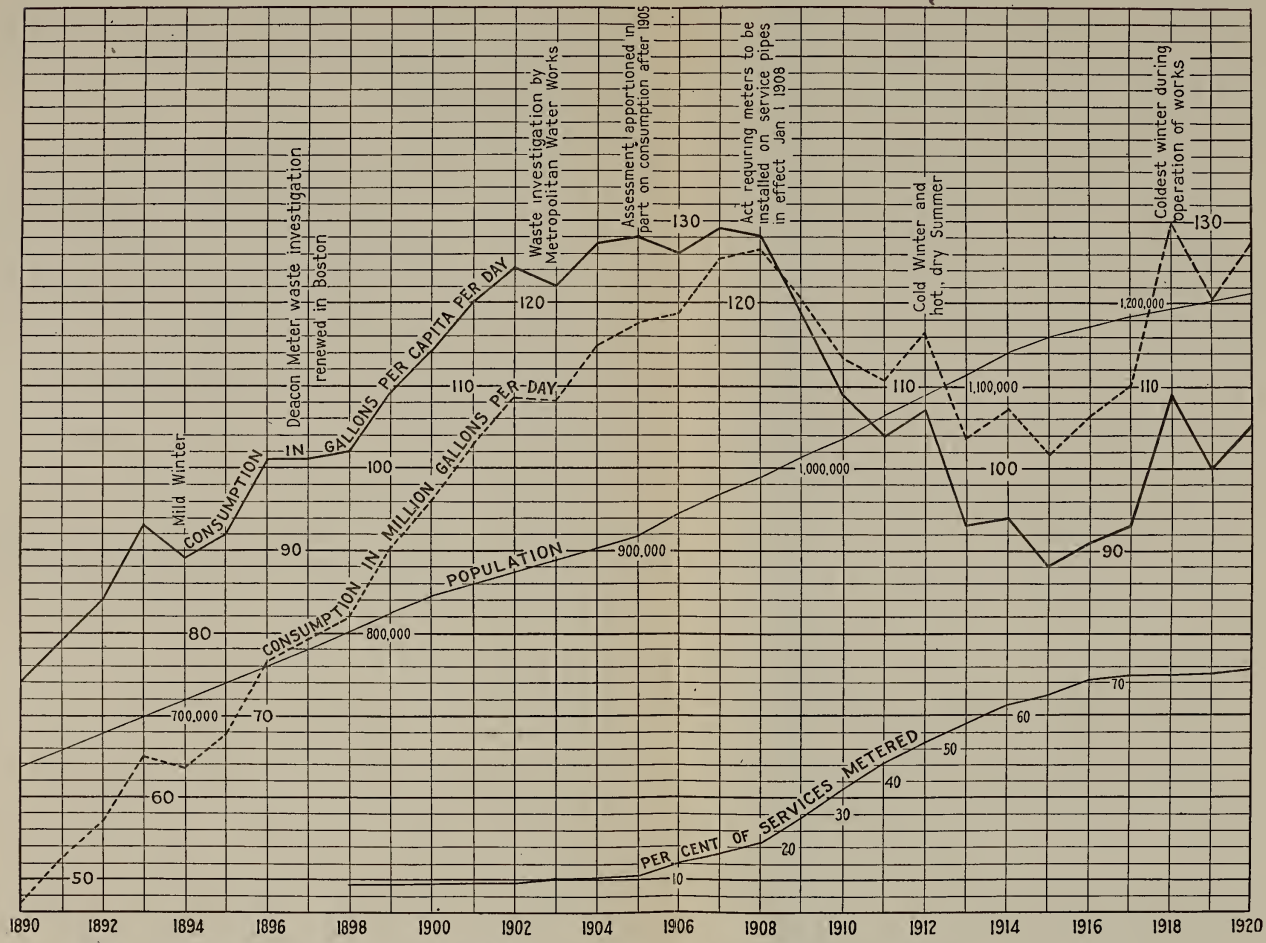
The population, consumption of water and per cent of services metered in the Metropolitan Water District as supplied in 1920, and for the period from 1890 to 1920, inclusive, are shown graphically by the accompanying diagram.

The average daily consumption of water in each of the municipalities in the Metropolitan Water District supplied during 1919 and 1920, as measured by the Metropolitan Water Works meters, is as follows: —

	Estimated Population, 1920.	Average Daily Consumption.				
		1919.		1920.		Increase in Gallons.
		Gallons.	Gallons per Capita.[1]	Gallons.	Gallons per Capita.	
Arlington,	18,780	1,085,700	59	1,055,600	56	30,100[2]
Belmont,	10,880	564,000	54	591,400	54	27,400
Boston,	751,810	89,652,400	120	94,297,400	125	4,645,000
Chelsea,	43,380	3,158,400	73	3,316,400	76	158,000
Everett,	40,350	2,886,700	72	3,455,200	86	568,500
Lexington,	6,390	389,200	62	424,300	66	35,100
Malden,	49,350	2,682,800	55	2,793,300	57	110,500
Medford,	39,460	1,688,500	44	1,739,700	44	51,200
Melrose,	18,270	1,057,100	59	1,108,100	61	51,000
Milton,	9,420	401,300	43	430,900	46	29,600
Nahant,	1,330	186,900	141	192,600	145	5,700
Quincy,	48,200	4,550,100	97	4,472,500	93	77,600[2]
Revere,	29,120	1,780,700	63	1,975,900	68	195,200
Somerville,	93,530	6,541,500	71	7,177,300	77	635,800
Stoneham,	7,890	602,400	77	789,600	100	187,200
Swampscott,	8,150	570,900	71	657,200	81	86,300
Watertown,	21,530	2,002,900	96	1,911,700	89	91,200[2]
Winthrop,	15,590	792,000	52	876,400	56	84,400
District,	1,213,430	120,593,500	100	127,265,500	105	6,672,000

[1] The populations for 1919 were revised after the census of 1920 became available and consequently these per capita figures differ from the figures published in the 1919 report. [2] Decrease.

POPULATION, CONSUMPTION OF WATER AND PER CENT OF SERVICES METERED IN THE METROPOLITAN WATER DISTRICT AS SUPPLIED IN 1920 FROM 1890 TO 1920



Note: Estimated population and consumption per capita given on diagram published in annual reports 1916 to 1919 inclusive have been revised and are here shown in accordance with 1920 census.

During 1920 there was an increase in consumption over 1919 in all municipalities supplied, with the exception of Arlington, Quincy and Watertown, but in the case of Quincy and Watertown there was a very large curtailment of the activities undertaken during the war. The consumption by districts in 1920 as compared with the consumption in 1919 is as follows: —

	Gallons per Day, 1920.	Increase from 1919.	
		Gallons per Day.	Percentage.
Southern low-service district, embracing the low-service district of Boston, with the exception of Charlestown and East Boston,	45,571,400	3,163,600	7.46
Northern low-service district, embracing the low-service districts of Somerville, Chelsea, Malden, Medford, Everett, Arlington, Charlestown and East Boston,	26,182,900	1,505,000	6.10
Southern high-service district, embracing Quincy and Watertown, the high-service districts of Boston, and portions of Belmont and Milton,	44,275,900	1,216,500	2.83
Northern high-service district, embracing Melrose, Revere, Winthrop, Swampscott, Nahant and Stoneham, and the high-service districts of Somerville, Chelsea, Malden, Medford, Everett and East Boston,	9,601,500	708,000	7.96
Southern extra high-service district, embracing the higher portions of Hyde Park, Milton and West Roxbury,	736,800	68,400	10.23
Northern extra high-service district, embracing Lexington and the higher portions of Arlington and Belmont,	897,000	10,500	1.18
Totals,	127,265,500	6,672,000	5.53

Installation of Meters on Service Pipes.

Information regarding the installation of meters on service pipes by the municipalities supplied with water from the Metropolitan Water Works is given in the accompanying table.

City or Town.	Services in Use Dec. 31, 1907.	Services equipped with Meters Dec. 31, 1907.	Number of Meters required to be set on Old Services Each Year.	Old Services in Use Dec. 31, 1920.	Old Services equipped with Meters Dec. 31, 1920.	Meters Set on Old Services 1908-1920, inclusive.	Number of Meters required to be set on Old Services 1908-1920, inclusive.	New Services installed and in Use Dec. 31, 1920.[1]	New Services equipped with Meters Dec. 31, 1920.[1]	Total Services in Use Dec. 31, 1920.	Total Services equipped with Meters Dec. 31, 1920.	Per Cent of Services metered Dec. 31, 1920.
Arlington,	1,929	835	55	1,799	1,799	964	715	1,519	1,519	3,318	3,318	100.00
Belmont,	792	792	–	753	753	–	–	1,150	1,150	1,903	1,903	100.00
Boston,	93,942	5,190	4,276	90,966	53,305	48,115	46,832[2]	16,742	13,977	107,708	67,282	62.46
Chelsea,	6,603	1,792	140	3,358[3]	3,332	1,540	1,820	1,898	1,890	5,256	5,222	99.35
Everett,	5,161	116	252	5,152	3,390	3,274	3,276	988	988	6,140	4,378	71.30
Lexington,	730	80	32	744	730	650	416	609	609	1,353	1,339	98.97
Malden,	7,055	6,780	14	6,993	6,934	154	182	1,413	1,252	8,406	8,186	97.38
Medford,	4,378	582	179	4,086	4,086	3,504	2,327	2,806	2,806	6,892	6,892	100.00
Melrose,	3,429	1,058	119	3,398	3,353	2,295	1,547	1,082	1,076	4,480	4,429	98.86
Milton,	1,285	1,285	–	1,276	1,276	–	–	940	940	2,216	2,216	100.00
Nahant,	410	90	16	410	307	217	208	364	272	774	579	74.81
Quincy,	6,091	1,480	230	5,885	5,294	3,814	2,990	5,142	4,813	11,027	10,107	91.66
Revere,	2,875	158	138	2,864	1,983	1,825	1,794	1,905	1,868	4,769	3,851	80.75
Somerville,	11,662	3,446	411	11,414	8,477	5,031	5,343	2,200	2,120	13,614	10,597	77.84
Stoneham,	1,331	30	65	1,320	1,318	1,288	845	376	372	1,696	1,690	99.65
Swampscott,	1,307	892	21	1,305	1,305	413	273	706	706	2,011	2,011	100.00
Watertown,	1,886	1,886	–	1,886	1,886	–	–	1,585	1,585	3,471	3,471	100.00
Winthrop,	2,074	70	100	2,033	2,019	1,949	1,300	985	985	3,018	3,004	99.54
Totals,	152,940	26,562	6,048	145,642	101,547	75,033	69,868	42,410	38,928	188,052	140,475	74.70

[1] The number of new services installed and the number of new services equipped with meters do not always agree for the reason that service pipes are installed but meters are not set until the buildings are permanently occupied.

[2] Boston: Number of meters required to be set each year on old services, 4,438 for 1908, 1909 and 1910; reduced to 4,225 in 1911 on account of reduction in number of old services and increased to 4,276 after 1911 on account of unmetered services acquired by the annexation of Hyde Park. Boston exempt from setting meters on old services in 1917 and 1918. (Chapter 269, Special Acts of 1917, and Chapter 45, Special Acts of 1918.)

[3] Chelsea: 2,810 services destroyed during conflagration in April, 1908; 987 metered services remained after conflagration.

During 1920, 2,865 service pipes and 4,778 meters were installed in the municipalities supplied from the Metropolitan Water Works and at the close of the year 188,052 service pipes and 140,475 meters were in use; 74.70 per cent of all the service pipes had been provided with meters; in six of the municipalities all of the service pipes were equipped with meters and in three other municipalities over 99 per cent of the service pipes were equipped with meters.

Water supplied Outside of Metropolitan Water District.

During the year 506,263,000 gallons of water were supplied from the Metropolitan Water Works for use outside the Metropolitan Water District, for which $8,652.90 was charged, as follows: —

Places supplied.	Total Quantity (Gallons).	Average Quantity (Gallons per Day).	Number of Days on which Water was supplied.	Amounts charged for Water supplied.
Westborough State Hospital,	72,983,000	199,400	366	$2,189 49
Town of Framingham: —				
From Sudbury Aqueduct,	186,500,000	512,362	364	4,476 00
From Filter-gallery at Farm Pond,	220,300,000	601,913	366	421 34
United States Government: —				
Peddock's Island,	15,757,000	43,100	366	986 07
Portion of town of Saugus,	10,723,000	29,300	366	580 00

Quality of the Water.

The yearly average results of the chemical analyses, made by the Department of Health of the Commonwealth since 1892, and of the biological and bacteriological examinations, made in the Metropolitan Water Works laboratory, of water from the service taps in Boston since 1898 are given in tables in Appendix No. 2.

During December some complaints were received of a noticeable taste and odor in the water, which was caused by growths of Aphanizomenon and Synura in some of the reservoirs.

Engineering.

In connection with the maintenance of the works the engineering force has made plans, estimates and reports in connection with the consideration of various matters, and has made record plans of water works lands and structures, and surveys and plans for land purchases and takings; has tested meters; made photographs, blue prints and analyses of coal and oil; calculated yields of watersheds; made current meter gagings; kept hydraulic and meteorological records; summarized power station and pumping station records; cared for the recording pressure gages, and supervised various water works operations.

In the Appendix are tables giving additional information relating to the operations of the Metropolitan Water Works for the year 1920 and the usual water works statistics.

Respectfully submitted,

WILLIAM E. FOSS,
Director and Chief Engineer.

Boston, January 3, 1921.

REPORT OF THE DIRECTOR AND CHIEF ENGINEER OF SEWERAGE DIVISION.

JAMES A. BAILEY, *Commissioner, Metropolitan District Commission.*

DEAR SIR: — The following report of the operations of the Metropolitan Sewerage Works for the year ending December 31, 1920, is respectfully submitted: —

ORGANIZATION.

The Director and Chief Engineer has charge of the design and construction of all new works, and of the maintenance and operation of all the works controlled by the Metropolitan District Commission for removing sewage from the twenty-six municipalities which comprise the metropolitan sewerage districts.

The following assistants have been employed during the year: —

Henry T. Stiff, ...	Senior Assistant Engineer, in charge of office and drafting room and of construction work.
Clarence A. Moore, . . .	Assistant Engineer, in charge of maintenance studies and records, and of construction work on the North Metropolitan System.
George W. Wood, . . .	Assistant Engineer, in charge of survey and field work in connection with the Wellesley extension construction.
Ralph W. Loud, ...	Assistant Engineer, in charge of survey and field work in connection with the Reading extension construction.
Thomas L. Whelan, . . .	Superintendent, North Metropolitan Sewerage District.
Arthur F. F. Haskell, . .	Superintendent, South Metropolitan Sewerage District.

In addition to the above, the number of engineering and other assistants employed during the year was 14, which includes 2 instrumentmen, 4 inspectors, 1 draftsman, 5 rodmen and engineering assistants, and 2 stenographers.

Obituary.

I wish to record the deaths of three men who have been prominently connected with the construction and maintenance of the metropolitan sewerage system.

Mr. George F. Greenlaw died of pneumonia on February 2, 1920, while yet in service as superintendent of the South Metropolitan Sewerage District. Mr. Greenlaw was born in Maine, May 12, 1850, and received an education fitting him for navigation. For a time he was employed as a ship captain in the coasting trade. Later he learned the mason's trade and became a practical builder. Following this he took up engineering and was associated with many engineering enterprises before he was employed on these works. His service on the metropolitan sewerage works began in 1890, when he was employed as inspector of construction work. Later he was appointed superintendent of maintenance of the South Metropolitan Sewerage District. His services were of great value to the works.

Mr. Henry J. Wright died of heart failure on May 28, 1920. He had been on the retired list since August 6, 1918. Mr. Wright was born in England August 6, 1848, and came to this country at an early age. He learned in England the trade of machinist, and later in this country that of mason. He had been employed in the construction of several large engineering works before he came to the metropolitan sewerage works. He was employed by the Metropolitan Sewerage Commission in 1890 as inspector of construction work, and later he was appointed superintendent of maintenance of the North Metropolitan Sewerage District. Even after retirement he used to visit the works and give information and advice as to details with which he was especially familiar. His services were of great value to the works.

Mr. William M. Brown, formerly Chief Engineer of the sewerage works, died on May 29, 1920, in Newark, N. J. At the time of his death he was Chief Engineer for the Passaic Valley Sewerage Commission. Mr. Brown was born in Rhode Island, August 13,

1854, and was educated at Brown University. Before his connection with the metropolitan sewerage works he had been employed in several engineering positions. He was appointed by the Metropolitan Sewerage Commission in 1890 to the position of assistant engineer in charge of construction work. In 1895 Mr. Brown was made Chief Engineer of the Metropolitan Sewerage System, and remained in that capacity until he resigned to accept a position as Chief Engineer for the Passaic Valley Sewerage Commission on February 21, 1912. During Mr. Brown's term as Chief Engineer of Metropolitan Sewerage Works, the maintenance of the system was organized and the works put into operation. Under his engineering supervision the Neponset valley sewer and the high-level sewer and many extensions of the metropolitan sewerage system were completed. His service of twenty-two years in the building and operation of the metropolitan sewerage system displayed a large constructive ability and an intimate knowledge of the details of maintenance. Faithful devotion and prompt execution and accomplishment characterized the performance of all his duties.

METROPOLITAN SEWERAGE DISTRICTS.

Areas and Populations.

During the year no changes have been made in the extent of the metropolitan sewerage districts.

The populations of the districts, as given in the following table, are based on the census of 1920.

Table showing Ultimate Contributing Areas and Present Estimated Populations within the Metropolitan Sewerage Districts, as of December 31, 1920.

	City or Town.	Area (Square Miles).		Estimated Population.	
North Metropolitan District.	Arlington,	5.20		19,000	
	Belmont,	4.66		11,130	
	Boston (portions of),	3.45		95,420	
	Cambridge,	6.11		110,500	
	Chelsea,	2.24		43,780	
	Everett,	3.34		40,820	
	Lexington,[1]	5.11		4,500	
	Malden,	5.07		49,850	
	Medford,	8.35		40,300	
	Melrose,	3.73		18,410	
	Reading,	9.82		7,530	
	Revere,	5.86		29,730	
	Somerville,	3.96		94,420	
	Stoneham,	5.50		7,940	
	Wakefield,	7.65		13,210	
	Winchester,	5.95		10,610	
	Winthrop,	1.61		15,860	
	Woburn,	12.71		16,680	
			100.32		629,690
South Metropolitan District.	Boston (portions of),	24.96		266,220	
	Brookline,	6.81		38,390	
	Dedham,[1]	9.40		10,870	
	Milton,	12.59		9,490	
	Newton,	16.88		46,520	
	Quincy,	12.56		48,830	
	Waltham,	13.63		31,260	
	Watertown,	4.04		21,660	
	Wellesley,	.9.89		6,380	
			110.76		479,620
	Totals,		211.08		1,109,310

[1] Part of town.

METROPOLITAN SEWERS.

Sewers Purchased and Constructed and their Connections.

During the year there have been built 2.652 miles of metropolitan sewers within the sewerage districts, so that there are now 117.572 miles of metropolitan sewers. Of this total, 9.642 miles of sewers, with the Quincy pumping station, have been purchased from cities and towns of the districts. The remaining 107.930 miles of sewers and other works have been constructed by the metropolitan boards.

The locations, lengths and sizes of these sewers are given in the following tables, together with other data referring to the public and special connections with the systems: —

North Metropolitan Sewerage System.

Location, Length and Sizes of Sewers, with Public and Special Connections.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1920.	Special Connections.	
				Character or Location of Connection.	Number in Operation.
Boston: —					
Deer Island,	4′ 0″ to 9′ 0″,	1.653	4	–	–
East Boston,	9′ 0″ to 1′ 0″,	5.467	25	Shoe factory,	1
				Middlebrook Wool-combing Co.,	1
Charlestown,	6′ 7″×7′ 5″ to 1′ 0″,	3.292	15	Navy Yard,	9
				Private building,	1
				Club House,	1
Winthrop,	9′ 0″,	2.864	13	Fire department station,	1
				Private building,	1
				Bakery,	1
				Rendering works,	1
Chelsea,	8′ 4″×9′ 2″ to 15″,	5.230	13	Metropolitan Water Works blow-off,	1
				Chelsea Water Works blow-offs,	2
				Naval Hospital,	1
				Metropolitan Water Works blow-off,	1
				CameronAppliance Co.,	1
				Shultz-Goodwin Co.,	1
Everett,	8′ 2″×8′ 10″ to 4′ 8″×5′ 1″,	2.925	8	Andrews-Wasgatt Co.,	1
				National Metallic Bed Co.,	1
				Linoide Co.,	1
				Factory,	2
				New England Structural Co.,	1
Lexington,	–	–	1	–	–
Malden,	4′ 6″×4′ 10″ to 1′ 0″,	5.844[1]	34	Metropolitan Water Works blow-off,	1
				Private buildings,	190[2]

[1] Includes 1.84 miles of sewer purchased from the city of Malden.

[2] Mostly buildings connected with sewers formerly belonging to city of Malden but later purchased by the Metropolitan Sewerage Commission in accordance with chapter 215 of the Acts of 1898 and by the Metropolitan Water and Sewerage Board in accordance with chapter 512 of the Acts of 1911 and made parts of the North Metropolitan Sewerage System.

North Metropolitan Sewerage System — *Concluded.*

Location, Length and Sizes of Sewers, with Public and Special Connections — Concluded.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1920.	Special Connections. Character or Location of Connection.	Special Connections. Number in Operation.
Melrose,	4′ 6″×4′ 10″ to 10″,	6.099[1]	39	Private buildings,	116[2]
				Factory,	1
				Railroad station,	1
				Park Department bath-house,	1
				Harvard dormitories,	2
				Slaughterhouse,	1
Cambridge,	5′ 2″×5′ 9″ to 1′ 3″,	7.209	45	City Hospital,	3
				Street railway machine shop,	1
				Private building,	1
				Factory building,	1
				Tannery,	1
				Slaughterhouses (3),	1
				Carhouse,	1
				Somerville Water Works blow-off,	1
Somerville,	6′ 5″×7′ 2″ to 10″,	3.577	12	Street railway power house,	1
				Stable,	1
				Rendering works,	1
				Railroad scale pit,	1
				Private building,	1
				Armory building,	1
Medford,	4′ 8″×5′ 1″ to 10″,	5.713	25	Private buildings,	9
				Stable,	1
				Police substation,	1
				Tanneries,	6
				Private buildings,	10
				Gelatine factory,	1
				Watch-hand factory,	1
				Stable,	1
Winchester,	4′ 6″ to 1′ 3″,	9.470	27	Railroad station,	2
				Felt works,	1
				Town Hall,	1
				Bay State Saw & Tool Co.,	1
				Whitney Machine Co.,	1
Stoneham,	1′ 8″ to 10″,	2.333	4	– –	–
Woburn,	1′ 10″×2′ 4″ to 1′ 3″,	0.713	3	Glue factory,	3
				Private buildings,	162[4]
Arlington,	1′ 6″ to 10″,	3.520[3]	43	Railroad station,	1
				Car-house,	3
				Post office,	1
Belmont,[5]	– –	–	3	– –	–
Wakefield,	3′ 0″ to 2′ 0″×2′ 3″,	0.577	1	– –	–
Revere,	4′ 0″ to 15″,	0.136	3	– –	–
Reading,	– –	0.055	–	– –	–
		66.677[6]	318		565

[1] Includes .736 of a mile of sewer purchased from the city of Melrose.

[2] Mostly buildings connected with a sewer formerly belonging to the city of Melrose but later purchased by the Metropolitan Sewerage Commission in accordance with chapter 414 of the Acts of 1896 and with a sewer extension built in accordance with chapter 436 of the Acts of 1897 by the Metropolitan Sewerage Commission as an outlet for part of the town of Stoneham and made parts of the North Metropolitan Sewerage System.

[3] Includes 2.631 miles of sewer purchased from the town of Arlington.

[4] Mostly buildings connected with a sewer formerly belonging to the town of Arlington but later purchased by the Metropolitan Sewerage Commission in accordance with chapter 520 of the Acts of 1897 and made a part of the North Metropolitan Sewerage System.

[5] The Metropolitan Sewer extends but a few feet into the town of Belmont.

[6] Includes 2.787 miles of Mystic valley sewer in Medford and Winchester, running parallel with the metropolitan sewer.

South Metropolitan Sewerage System.

Location, Length and Sizes of Sewers, with Public and Special Connections.

City or Town.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1920.	Special Connections. Character or Location of Connection.	Special Connections. Number in Operation.
Boston: —				Tufts Medical School,	1
				Private house,	1
Back Bay,	6′ 6″ to 3′ 9″,	1.500[1]	16	Administration Building, Boston Park Department,	1
				Simmons College Buildings,	1
				Art Museum,	2
Brighton,	5′ 9″×6′ 0″ to 12″,	6.010[2]	15	Abattoir,	3
				Chocolate works,	2
				Machine shop,	1
Dorchester,	3′×4′ to 2′ 6″×2′ 7″,	2.870[3]	13	Paper Mill,	1
				Private buildings,	3
				Edison Electric Company Station,	1
				Mattapan Paper Mills,	1
Hyde Park,	10′ 7″×11′ 7″ to 4′ 0″×4′ 1″,	4.527	18	Private buildings,	2
				Fairview Cemetery Buildings,	1
Roxbury,	6′ 6″×7′ to 4′ 0″,	1.430	–	– –	–
				Caledonia Grove buildings,	1
West Roxbury,	9′ 3″×10′ 2″ to 12″,	7.643	16	Parental School,	1
				Lutheran Evangelical Church,	1
				Private buildings,	4
Brookline,	6′ 6″×7′ 0″ to 8″,	2.540[4]	12	Private buildings,	2
Dedham,	4′×4′ 1″ to 2′ 9″×3′,	4.622	7	Dedham Carpet Mills,	1
Hull,[5]	60″ pipe,	0.750	–	– –	–
Milton,	11′×12′ to 8″,	3.600	23	Private buildings,	2
Newton,	4′ 2″×4′ 9″ to 1′ 3″,	2.911	8	Private houses,	7
				Metropolitan Water Works blow-off,	1
Quincy,	11′ 3″×12′ 6″ to 24″ pipe,	6.845	15	Squantum schoolhouse,	1
Waltham,	3′ 6″×4′ 0″,	0.001	1	– –	–
				Factories,	2
Watertown,	4′ 2″×4′ 9″ to 12″,	0.750[6]	6	Stanley Motor Carriage Co.,	1
				Knights of Pythias building,	1
Needham,[5]	2′ 0″×2′ 3″ to 2′ 3″×2′ 6″,	4.896	–	– –	–
Wellesley,[7]	– –	–	–	– –	–
		50.895	150		46

[1] Includes .355 of a mile of sewer purchased from the city of Boston.

[2] Includes .446 of a mile of pipe and concrete sewers built for the use of the city of Boston; also .026 of a mile of sewer purchased from the town of Watertown.

[3] Includes 1.24 miles of sewer purchased from the city of Boston.

[4] Includes .158 of a mile of pipe sewer built for the use of the town of Brookline.

[5] Hull and Needham are not parts of the Metropolitan Sewerage District.

[6] Includes .025 of a mile of sewer purchased from the town of Watertown.

[7] The metropolitan sewer extends but a few feet into the town of Wellesley.

Information relating to areas, populations, local sewer connections and other data for the metropolitan sewerage districts appears in the following table: —

North Metropolitan Sewerage District.

Area (Square Miles).	Estimated Total Population.	Miles of Local Sewer connected.	Estimated Population contributing Sewage.	Ratio of Contributing Population to Total Population (Per Cent).	Connections made with Metropolitan Sewers.	
					Public.	Special.
100.32	629,690	785.26	574,850	91.3	318	565

South Metropolitan Sewerage Disirict.

110.76	479,620	674.88	363,200	75.7	150	46

Both Metropolitan Sewerage Districts.

211.08	1,109,310	1,460.14	938,050	84.6	468	611

Of the estimated gross population of 1,109,310 on December 31, 1920, 938,050, representing 84.6 per cent, were on that date contributing sewage to the metropolitan sewers, through a total length of 1,460.14 miles of local sewers owned by the individual cities and towns of the districts.

These sewers are connected with the metropolitan systems by 468 public and 611 special connections. During the current year there has been an increase of 14.06 miles of local sewers connected with the metropolitan systems, and 2 public and 8 special connections have been added.

CONSTRUCTION.

NORTH METROPOLITAN SEWERAGE SYSTEM.

Reading Extension.

For the disposal of sewage from the town of Reading a covered concrete reservoir has been constructed near the corner of Summer Avenue and Elm Street in Reading having a capacity of about 250,000 gallons. A pumping station will be built at this point at which sewage will be raised about 65 feet through a cast-iron force main to a point where it will flow by gravity into the metropolitan sewers. These are all included in Section 76.

Part of Section 76, Reading Extension. — Inlet Sewer, Reservoir, Pump Well, Pumping Station Foundations and Cast-iron Force Main.

This work extends from a point in Hopkins Street, Wakefield, northerly through lands of Herbert M. Hopkins and George A. Forbes, to a point in Summer Avenue, Wakefield. A part of these structures is in the town of Reading.

A contract for the construction of this work was entered into by the Commission, some particulars of which are as follows: —

Date of contract No. 1 (Sewerage Division),	February 11, 1920.
Name of contractor,	Bruno & Petitti.
Concrete inlet sewer: —	
Dimensions,	3-feet diameter.
Length,	100 feet.
Concrete reservoir: —	
Length of reservoir,	100 feet.
Height of reservoir,	18 feet.
Width of reservoir,	20 feet.
Average depth of excavation,	38 feet.
Pumping station foundations: —	
Dimensions,	27 by 42 feet.
Depth of excavation for pump well,	42 feet.
Cast-iron force main: —	
Diameter,	16 inches.
Length,	1,370 feet.
Assistant engineer in charge of construction,	Ralph W. Loud.

The inlet sewer, reservoir and pump well were constructed largely in rock, the rock excavation ranging in depth from 18 to 36 feet. A small amount of ground water was encountered. A concrete conduit was constructed along the pumping station site and across the reservoir location to carry the flow of a brook. All work is completed excepting minor repairs over the surface.

Section 75. — Reading Extension.

This section extends in Stoneham and Wakefield from a point in land of Cornelius J. Sweeney, northerly through said land of Sweeney, and lands of Mary A. Scally, Elizabeth L. McGrady, Margaret McLaughlin, Annie E. Greene, Ellen Magner, Richard C. Christie, Carl and Emilia Christiansen, Ida A. Nilsson, Bridget

Mary McCarty and John B. Tidd, crossing Main Street, thence through lands of Walter Steele and Betty K. Farr, passing through a portion of North Street, thence through lands of Emma C. and Ruth G. Prescott, Bear Hill Associates, Inc., Joseph E. Hopkins, and Herbert M. Hopkins to a point in Hopkins Street, Wakefield. A contract for the construction of this work was entered into by the Commission, some particulars of which are as follows: —

Date of contract No. 4 (Sewerage Division),	September 29, 1920.
Name of contractor,	Antony Cefalo.
Length of section,	5,486 feet.
Average depth of excavation,	7 feet.
Dimensions of pipe sewer,	15, 18 and 20 inches.
Assistant engineer in charge of construction,	Ralph W. Loud.

This work has been constructed in shallow trenches and with very little difficulty. Rock was encountered from Station 24+65 to Station 25+96, and from Station 53+30 to Station 54+86. From Station 0 to Station 1+50 a foundation of bowlder concrete was provided. That part of the sewer which was laid through the limits of the ice pond extending from Station 0 to Station 3+72 was surrounded by concrete. The 15, 18 and 20 inch pipe used on this section is of double strength Buckeye Akron pipe. At the crossing of a drainage brook near Station 51+34, 16-inch cast-iron pipes were used. The work on this section is practically completed.

The funds appropriated under chapter 159 of the General Acts of 1916 have been exhausted. A pumping station must be constructed and pumps installed therein. It has been planned that these shall be operated by electricity purchased from the town of Reading. If the appropriation asked for is received early in the season, this line can be put into operation by September 1, 1921.

SOUTH METROPOLITAN SEWERAGE SYSTEM.

Wellesley Extension.

At the beginning of this year there remained to be constructed a part of Section 99, all of Section 100 and all of Section 101. A contract was let, as noted in last year's report, for the construction of the remainder of Section 99. This contract was terminated by an arrangement between the Commission and the contractor, as the latter did not have the necessary funds for completing the work.

Part of Section 99, Trench and River Crossing. — Station 18+75 to Station 33+00. Wellesley Extension.

A new contract was entered into for the completion of this section, some particulars of which are as follows: —

Date of contract No. 3 (Sewerage Division),	May 29, 1920.
Name of contractor,	Rendle-Stoddard Company.
Length of section,	1,425 feet.
Average depth of cut in trench,	11 feet.
Dimensions of concrete sewer,	33 by 36 inches.
Cast-iron pipe river crossing,	30 inches.
Assistant engineer in charge of construction work,	George W. Wood.

Work was begun under this contract on May 29, 1920. At the end of the year the work had been practically completed. There remain some backfilling and clearing up of right of way. In this section there is a river crossing which was completed by means of 30-inch cast-iron pipe laid on a pile foundation. The pipe joints were calked with lead. No serious difficulty was encountered in the construction of this work, although a considerable amount of ground water was encountered.

Section 100. Wellesley Extension.

This section extends in Dedham from a point in land of Stephen M. Weld, westerly through land of said Weld and land of Frederick P. Royce, *et al.*, Trustees, thence through other land of said Weld and other land of said Trustees to a point in Common Street near Charles River. A contract for the completion of this work was entered into by the Commission, some particulars of which are as follows: —

Date of contract No. 2 (Sewerage Division),	May 19, 1920.
Name of contractor,	Bruno & Petitti.
Length of section,	3,921 feet.
Average depth of sewer in trench,	13 feet.
Dimensions of concrete sewer,	33 by 36 inches.
Assistant engineer in charge of construction,	George W. Wood.

At the end of the year there remained 400 feet to be completed on this section. Rock was encountered from Station 22+85 to Station 24+75, and from Station 30+15 to Station 36+40. It is expected that this work will be completed in the early spring. A considerable amount of ground water has been encountered.

Section 101. Wellesley Extension.

This section extends from Common Street in Dedham along the southerly side of Charles River through private lands, and crosses Dedham Avenue, private land and Charles River to a point in the town of Needham. The total length is 3,840 feet. A contract for the construction of this section was entered into by the Metropolitan Water and Sewerage Board, some particulars of which are as follows: —

Date of contract No. 145 (Sewerage Works),	September 17, 1919.
Name of contractor,	Rendle-Stoddard Company.
Length of section,	3,840 feet.
Average depth of sewer in trench,	8 feet.
Dimensions of concrete sewer,	33 by 36 inches.
Dimensions of cast-iron siphon,	16 inches.
Assistant engineer in charge of construction,	George W. Wood.

By permission of the Board the contractor was allowed to complete other work for the Board before starting on this section. This was done because of the scarcity of labor. Work was started on this section under the above contract on January 14, 1920. At the end of the year there had been completed 2,425 feet. This section has been constructed in a shallow trench near the river.

During the early part of the season considerable delay in the construction of these sections was occasioned by scarcity of labor, also by reason of the high water of the Charles River, owing to the abnormal rainfall, and also by the difficulty which the contractors found in getting cement and other material.

To complete the Wellesley extension there remains to be built 1,815 feet of sewer, including a river crossing near Dedham Avenue. Work will probably be completed early in the summer of 1921.

MAINTENANCE.

SCOPE OF WORK AND FORCE EMPLOYED.

The maintenance of the metropolitan sewerage system includes the operation of 7 pumping stations, the Nut Island screen-house, and 117.572 miles of metropolitan sewers receiving the discharge from 1,460.14 miles of town and city sewers at 468 points, together with the care and study of inverted siphons under streams and in the harbor.

The permanent maintenance force at present includes 160 men, of whom 99 are employed on the North System and 61 on the South System. These are subdivided as follows: North Metropolitan System, 64 engineers and other employees in the pumping stations, and 35 men, including foremen, on maintenance, care of sewer lines, buildings and grounds; South Metropolitan System, 36 engineers and other employees in the pumping stations, and 25 men, including foremen, on maintenance, care of sewer lines, buildings and grounds.

The regular work of this department, in addition to the operation of the pumping stations, has consisted of routine work of cleaning and inspecting sewers and siphons, caring for tide gates, regulators and overflows, measuring flow in sewers, inspection of connections with the metropolitan sewers, and the care of pumping stations and other buildings and grounds.

In addition to these regular duties other work has been done by the maintenance employees of this department as follows: —

Deer Island Pumping Station.

During the early spring the grass slopes back of the coal house slipped down, and considerable work was necessary in replacing and reseeding. A portion of the work was replaced by a concrete face.

A 2-inch lead-lined iron pipe has been laid from the institution reservoir at the top of the hill to connect with the feed-water piping of the pumping station. This was done so as to insure a supply for the boilers in case of accident to the institution piping on Deer Island, through which the ordinary supply at the station is obtained.

Steam heat and electric lights were installed in the storehouse and stable in order to lessen fire hazard.

A new piston was furnished for the low-pressure cylinder of engine No. 1. The impeller wheel on engine No. 3 had become

loosened by corrosion. This was reset and a 10-inch brass sleeve was put on the shaft and new bearings were installed. Two new condenser pump cylinders were made and put in place for this pumping engine.

Charlestown Pumping Station.

At this station a basement gallery has been extended the length of the building on the west side. This enables the pipes, which formerly had been located in a shallow trench and at places buried in earth or concrete, to be exposed to view, and to be easily reached in case of repair work.

The moving of the street about 30 feet to the westward during the reconstruction of the Malden bridge over the Mystic River left a strip of land between it and the station. This has been improved by building through it a driveway with concrete curb and gutters, and the loaming and seeding of the remainder.

A brick house built over the shaft in the Charlestown playground was originally covered with a red-tile roof. This roof was exposed to the assaults of vandals, and it was impossible to keep it in repair. The police were appealed to, but they said that inasmuch as it was a public playground it was extremely difficult for them to guard it. A concrete roof was substituted for the tile roof.

Sewer Line Repairs.

During the period of high flow occasioned by the melting of the snows in March the pipe sewer at Tremont Street, Melrose, overflowed through one of its manholes. A 16-inch cast-iron pipe has been laid from this manhole to another metropolitan sewer located in the same street. This connection is made at Station 5+81 of Section 50.

The head houses at the river crossing on the Revere extension had become damaged by exposure to storms. These were repaired by relaying the brickwork and surrounding it with reinforced concrete.

Repairs were made on the tide gates and masonry walls at the Belle Isle Inlet overflow.

Ward Street Pumping Station.

A Lincoln electric welding machine and a Waterhouse acetylene heating and welding outfit were installed at this station to be used in connection with repair work. Much repair work that formerly had been sent out to be done is now accomplished at this station.

Nut Island Screen-house and Yard.

At this station considerable machinist work has been done for other portions of the line. This station is equipped with a lathe, grinding machinery, a shaper and an upright drill. A large amount of brass foundry work is done here averaging $1\frac{1}{2}$ tons per year of finished castings. These are made for all parts of the Metropolitan Sewerage Works.

A new landing float 32 feet long and 8 feet wide was constructed for use at the Nut Island wharf.

The concrete fence on the westerly side of the bar leading to Nut Island has been completed during the year. A new fence was built at the sides of Pawsey Road (so called), which extends along and across Section 48, high-level sewer.

Repairs were made on the fence at Nut Island stockyard.

During a violent storm in the latter part of November the 43-foot naphtha towboat broke from its moorings and was driven on to the riprap slopes of Nut Island bar. The keel and boarding were much damaged, also the rudder and propeller. Repairs have been made.

Quincy Pumping Station.

The pumping engines at this station were repainted.

Elbridge M. Walker, assistant operating engineer at this station, was retired at his request because of physical disability on September 30, 1920.

A new steam valve was made and installed in engine No. 3 for the high-pressure cylinder.

Settlements occurred in the grounds surrounding this station, making it necessary to regrade and reseed considerable portions of the same.

Government Use of Old 24-inch Quincy Force Main.

The sewerage connection of the shipbuilding plant at Squantum, Quincy, with the 24-inch cast-iron force main in Squantum Street, has been in use during the year. Since June 1, 1920, this plant has been operated as a part of the Charlestown Navy Yard, and is wholly under government control. The sewage discharged through the force main has averaged about 75,000 gallons per 24 hours. This sewage is discharged through the Boston main drainage outfall works at Moon Island.

Gasolene in Public Sewers.

The efforts to improve the condition of the metropolitan sewers in regard to dangers resulting from the introduction of gasolene into the same have been continued throughout the year and have been successful.

An inspector has been employed in this Department whose duty it is to visit existing garages and see that the separators are kept in proper condition; also to enforce the regulation concerning the installation of such separators at all newly constructed garages.

The abnormally large rainfall of 1920 caused the metropolitan sewers to be surcharged at some points. This was particularly so in Cambridge. The condition resulted in a collection of oil and gasolene at the manholes where the water surface rose above the sewer arches. This material was analyzed by the chemist of the State Department of Health and was found to contain fully 75 per cent of gasolene. About 70 barrels of the mixture were removed from the sewers and disposed of otherwise. Notice was sent to the Department of Public Safety.

During the year 154 new garages and other establishments using gasolene have been connected with the local sewer systems which discharge into the metropolitan sewers.

The following tables show the particulars in regard to establishments known to be using gasolene and which are connected with the public sewerage systems of the different municipalities in the metropolitan sewerage districts: —

North Metropolitan Sewerage District.

Table showing Number of Places where Gasolene is used connected with Public Sewers, and Progress of Work of installing Separators to December 31, 1920.

City or Town.	Number of Places connected with Sewer.	Number of Places originally having Acceptable Separators.	Number of Places where Changes have been made.	Number of New Garages built, 1920.	Remarks.
Arlington,	6	–	3	–	–
Belmont,	4	–	3	–	–
Boston: —					
Charlestown district,	26	–	19	1	–
East Boston district,	29	–	17	3	–
Cambridge,	145	–	108	36	–
Chelsea,	29	–	13	5	–
Everett,	24	–	14	8	–
Lexington,	2	–	–	1	–
Malden,	26	–	20	3	–
Medford,	16	–	13	–	–
Melrose,	7	–	5	–	–
Revere,	13	–	3	1	–
Somerville,	87	8	32	35	–
Stoneham,	7	–	6	1	–
Wakefield,	6	–	6	–	–
Winchester,	14	–	14	–	–
Winthrop,	4	–	4	–	–
Woburn,	4	–	3	1	–
Reading,	–	–	–	–	Not yet connected with metropolitan sewer.
Totals,	449	8	283	95	

South Metropolitan Sewerage District.

Table showing Number of Places where Gasolene is used connected with Public Sewers, and Progress of Work of installing Separators to December 31, 1920.

City or Town.	Number of Places connected with Sewer.	Number of Places originally having Acceptable Separators.	Number of Places where Changes have been made.	Number of New Garages built, 1920.	Remarks.
Boston: —					
Hyde Park district,	15	–	8	–	–
West Roxbury district,	36	10	16	5	–
Back Bay district,	60	22	26	1	–
Brighton district,	75	22	28	14	–
Dorchester district,	46	20	11	5	–
Jamaica Plain district,	3	–	–	3	–
Mattapan district,	–	–	–	–	–
Brookline,	96	9	54	19	–
Dedham,	3	3	–	–	–
Milton,	1	1	–	–	–
Newton,	52	18	23	6	–
Quincy,	21	–	15	4	–
Waltham,	12	5	1	2	–
Watertown,	17	3	13	–	–
Wellesley,	–	–	–	–	Not yet connected with metropolitan sewer.
Totals,	437	113	195	59	

Drainage from Tanneries, Gelatine and Glue Works in Winchester, Woburn and Stoneham.

Four men and a foreman have been employed during a part of the year flushing and cleaning the metropolitan sewers through the tannery districts in Winchester, Woburn and Stoneham.

All the tanneries and glue works of the district now have settling tanks of substantial size. This method of treatment has very greatly reduced the amount of sludge material entering the metropolitan sewers.

The following table gives details of settling tanks introduced to date, showing the operations of same, with the amount of sludge collected and removed: —

Table of Semi-fluid Sludge removed from Settling Basins at the Tanneries, Gelatine and Glue Works in Winchester, Woburn and Stoneham, Year ending December 31, 1920.

Location of Basin.	Basin in Operation.	Inside Measurement of Basin (Feet).	Number of Times cleaned during Year.	Average Quantity Semi-fluid Sludge removed during Year (Cubic Yards).	Total Quantity Semi-fluid Sludge removed during Year (Cubic Yards).
Beggs & Cobb Company, rotary screen process.[1]	Dec. 12, 1917	–	–	–	276.00
Beggs & Cobb Company, wooden settling basin.	Aug. 12, 1919	6.0× 4.0	51	–	776.00
Beggs & Cobb Company, outlet intercepting sump.	July 16, 1919	12.0× 8.0	2	11.00	22.00
American Hide and Leather Company, Factory D.	Nov. 15, 1910	48.0×23.1	4	139.50	558.00
Dorington Leather Company, . . .	Dec. 10, 1910	47.2×23.0	3	106.84	320.52
E. Cummings Leather Company, . .	Nov. 1, 1910	45.9×22.6	2	97.60	195.20
W. P. Fox & Sons, ...	July 12, 1910	47.8×22.6	10	270.40	2,740.00
Thayer & Foss, ...	Sept. 15, 1910	48.1×23.1	13	209.80	2,727.00
Van Tassell Leather Company,[2] . .	May 1, 1911	10.2×14.5	–	–	–
Van Tassell Leather Company, . .	May 1, 1911	43.8×19.5	5	102.00	510.00
Van Tassell Leather Company,[2] . .	Dec. 26, 1919	6.0× 4.0	–	–	–
American Glue Company, . . .	Oct. 1, 1910	47.1×23.0	10	136.36	1,363.60
J. O. Whitten Company,[1]	1902	35.5×24.7	26	58.74	1,527.24
J. O. Whitten Company,[1]	1902	67.2×12.0	26	8.50	221.00
Morris Kaplan,[2]	Jan. 9, 1911	46.8×22.9	–	–	–
Morris Kaplan, ...	Jan. 9, 1911	4.0× 4.0	52	1.00	52.00
S. C. Parker & Son, [2], [3], ...	Aug. 1, 1910	48.3×23.0	–	–	–
Beggs & Cobb Company, Basin No. 1,[2] .	Jan. 15, 1910	47.0×23.0	–	–	–
Beggs & Cobb Company, Basin No. 2,[2] .	May 9, 1910	47.0×23.0	–	–	–
Beggs & Cobb Company, Basin No. 3,[2] .	Oct. 19, 1911	51.0×25.0	–	–	–
Atlantic Gelatine Company,[1] . . .	Mar. 12, 1920	30-ft. diameter.	–	–	100.00
Total, ...	–	–	–	–	11,388.56

[1] Daily, continuous. [2] Not used in 1920. [3] Burned in December, 1920.

North Metropolitan Sewerage System.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewers connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1920.]

Cities and Towns.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.[1]	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
Boston (Deer Island),	0.70	Separate,	–	–	230[2]	230	–	–	100.00	–
Winthrop,	32.48	Separate,	3,078	5.10	15,700	15,860	1.40	1.61	99.00	87.0
Boston (East Boston),	34.02	Separate and combined,	5,144	11.75	60,440	60,920	1.17	2.18	99.20	53.7
Chelsea,	31.12	Separate and combined,	4,294	10.00	42,940	43,780	1.15	2.24	98.10	51.3
Everett,	48.27	Separate and combined,	5,194	6.90	35,840	40,820	2.02	3.34	87.80	60.5
Malden,	67.18	Separate,	7,264	6.40	46,490	49,850	3.16	5.07	93.30	62.3
Melrose,	39.60	Separate,	3,422	4.60	15,740	18,410	1.90	3.73	85.50	50.9
Boston (Charlestown),	21.70	Separate and combined,	5,471	6.25	34,190	34,270	0.67	1.27	99.80	52.8
Cambridge,	157.26	Separate and combined,	16,940	6.50	110,110	110,500	5.05	6.11	99.60	82.7
Somerville,	101.61	Separate and combined,	16,076	5.80	93,240	94,420	3.50	3.96	98.80	88.4
Medford,	66.46	Separate,	6,382	6.20	39,570	40,300	3.21	8.35	98.20	38.4
Winchester,	33.21	Separate,	2,069	5.10	10,550	10,610	1.64	5.95	99.40	27.6
Woburn,	16.35[3]	Separate,	1,309	5.60	7,330	16,680	1.03	12.71	43.90	8.1
Stoneham,	13.55	Separate,	992	4.70	4,660	7,940	0.71	5.50	58.70	12.9
Arlington,	33.61	Separate,	2,541	6.20	15,750	19,000	2.03	5.20	82.90	39.0
Belmont,	22.66	Separate,	1,445	6.70	10,170[4]	11,130	1.37	4.66	91.40	29.4
Wakefield,	14.68	Separate,	863	5.30	4,570	13,210	0.62	7.65	34.60	8.1
Lexington,	6.64	–	101	4.60	460	4,500	0.24	5.11	10.20	4.7
Revere,	44.16	Separate,	3,838	7.00	26,870	29,730	2.15	5.86	90.40	36.7
Reading,[5]	–	–	–	–	–	7,530	–	9.82	–	–
Totals,	785.26	–	86,423	6.70	574,850	629,690	33.02	100.32	91.30	32.9

[1] Estimated from assessors' statement of the number of houses in each city or town on April 1, 1920, and the population from census of 1920.

[2] Estimated by Supt. Geo. M. Harlow of the institution on Deer Island.

[3] Exclusive of Mystic valley sewer and tanneries.

[4] Including 2 connections with McLean Hospital, having an estimated population of 485.

[5] Reading not yet connected.

South Metropolitan Sewerage System.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewers connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1920.]

Cities and Towns.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.[1]	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
Boston (Back Bay),	26.65	Separate and combined,	1,911	16.9	32,300	32,520	1.15	1.61	99.3	71.4
Boston (Brighton),	65.27	Separate and combined,	4,109	10.2	41,910	42,100	3.27	3.74	99.5	87.4
Brookline,	75.20	Separate and combined,	5,107	7.5	38,300	38,390	3.65	6.81	99.8	53.6
Newton,	133.41	Separate,	8,002	5.5	44,010	46,520	8.03	16.88	94.6	47.6
Watertown,	48.21	Separate,	3,065	7.0	21,460	21,660	2.34	4.04	99.1	57.9
Waltham,	47.63	Separate,	3,980	7.6	30,250	31,260	2.45	13.63	96.8	18.0
Boston (Dorchester),	58.81	Separate and combined,	6,051	9.0	54,460[2]	83,260[2]	2.58	4.89	65.4[2]	52.8
Milton,	18.53	Separate and combined,	1,123	5.0	5,620	9,490	1.01	12.59	59.2	8.0
Boston (Hyde Park),	35.23	Separate,	2,487	7.4	18,400	18,930	1.66	4.57	97.2	36.3
Dedham,	17.40	Separate,	927	5.6	5,190	10,870[3]	0.87	9.40	47.7	9.3
Boston (Roxbury),[4]	–	–	–	–	–	47,180[2]	–	1.23	–	–
Boston (West Roxbury),	61.49	Separate and combined,	4,144	6.7	29,970[5, 2]	42,230[2]	2.77	8.92	71.0[2]	31.1
Quincy,	87.05	Separate,	6,889	6.0	41,330	48,830	3.63	12.56	84.6	28.9
Wellesley,[6]	–	–	–	–	–	6,380	–	9.89	–	–
Totals,	674.88	–	47,795	7.6	363,200	479,620	33.41	110.76	75.7	30.2

[1] Estimated from assessors' statement of the number of houses in each city or town on April 1, 1920, and the population from census of 1920.

[2] Parts of Dorchester, Milton, Roxbury and West Roxbury which are situated within the South Metropolitan Sewerage System limits are tributary at present to Boston main drainage works.

[3] Part of town not included in Metropolitan Sewerage District.

[4] At present connected with Boston main drainage system.

[5] Including connection with institutions at Austin Farm, having an estimated population of 2,205.

[6] Wellesley not yet connected with metropolitan sewer.

Both Metropolitan Sewerage Systems.

Table showing Areas delivering Sewage to both Systems; Approximate Miles of Sewers connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1920.]

System.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
North Metropolitan, .	785.26	Separate and combined,	86,423	6.7	574,850	629,690	33.02	100.32	91.3	32.9
South Metropolitan, .	674.88	Separate and combined,	47,795	7.6	363,200	479,620	33.41	110.76	75.7	30.2
Totals, . . .	1,460.14	– –	134,218	7.0	938,050	1,109,310	66.43	211.08	84.6	31.5

PUMPING STATIONS.

Capacities and Results.

The following table shows the comparison of the growth in the amount of sewage handled and the total cost of the operation of the different stations in 1920 with the same items of 1919 and of 1914 when prices had not been affected by the war: —

Pumping Station.	Sewage pumped in 1920 increased over that of —		Cost of Operation in 1920 increased over that of —	
	1919.	1914.	1919.	1914.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Deer Island,	5	27	32	121
East Boston,	5	27	31	101
Charlestown,	8	27	20	76
Alewife Brook,	6	48	23	62
Quincy,	4	49	59	125
Ward Street,	2	29	46	112

Average Daily Volume of Sewage lifted at Each of the Six Principal Metropolitan Sewerage Pumping Stations and at the Quincy (Hough's Neck) Sewage Lifting Station during the Year, as compared with the Corresponding Volumes for the Previous Year.

Pumping Station.	Average Daily Pumpage.			
	Jan. 1, 1920, to Dec. 31, 1920.	Jan. 1, 1919, to Dec. 31, 1919.	Increase during the Year.	
	Gallons.	Gallons.	Gallons.	Per Cent.
Deer Island,	74,000,000	70,300,000	3,700,000	5.3
East Boston,	72,000,000	68,300,000	3,700,000	5.4
Charlestown,	41,400,000	38,400,000	3,000,000	7.8
Alewife Brook,	5,156,000	4,888,000	268,000	5.5
Quincy,	5,918,000	5,693,000	225,000	4.0
Ward Street (actual gallons pumped),	34,261,000	33,759,000	502,000	1.5
Quincy (Hough's Neck) sewage lifting station.	225,600	205,500	20,100	9.8

North Metropolitan System.

Deer Island Pumping Station.

At this station are four submerged centrifugal pumps with impeller wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons, with 19-foot lift.
Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.
Average duty for the year: 53,900,000 foot pounds.
Average quantity raised each day: 74,000,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 4 oilers, 3 screen men, 1 relief screen man and 1 laborer.
Coal used: bituminous, costing from $8.50 to $17.50 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Deer Island Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1920.						
January,	2,060,300,000	66,500,000	54,200,000	83,900,000	9.09	55,000,000
February,	2,097,300,000	72,300,000	57,000,000	98,300,000	9.48	53,000,000
March,	3,668,600,000	118,300,000	62,500,000	151,200,000	11.88	55,900,000
April,	3,058,400,000	101,900,000	68,200,000	144,600,000	11.81	58,200,000
May,	2,678,500,000	86,400,000	58,300,000	151,400,000	11.18	56,500,000
June,	2,773,500,000	92,500,000	74,800,000	149,800,000	11.21	59,000,000
July,	2,088,100,000	67,400,000	51,700,000	89,100,000	10.56	66,700,000
August,	1,605,000,000	51,800,000	42,200,000	67,200,000	10.82	51,900,000
September,	1,616,000,000	53,900,000	34,500,000	88,200,000	10.30	43,600,000
October,	1,519,200,000	49,000,000	39,300,000	72,100,000	11.17	53,800,000
November,	1,886,700,000	62,900,000	42,600,000	139,400,000	11.09	52,700,000
December,	2,034,000,000	65,600,000	51,400,000	100,000,000	11.24	40,700,000
Total,	27,085,600,000	–	–	–	–	–
Average,	–	74,000,000	53,100,000	111,300,000	10.82	53,900,000

Average Cost per Million Foot Gallons for Pumping at the Deer Island Station.

Volume (27,085.6 Million Gallons) × Lift (10.82 Feet) = 293,066.2 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor,	$27,173 24	$0.09272
Coal,	34,335 00	0.11716
Oil,	1,003 69	0.00342
Waste,	161 46	0.00055
Water,	1,517 16	0.00518
Packing,	297 21	0.00101
Miscellaneous supplies and renewals,	2,394 62	0.00817
Totals,	$66,882 38	$0.22821
Labor at screens,	$5,086 52	-

East Boston Pumping Station.

At this station are four submerged centrifugal pumps, with impeller wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons with 19-foot lift.
Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.
Average duty for the year: 70,800,000 foot pounds.
Average quantity raised each day: 72,000,000 gallons.
Force employed: 4 engineers, 2 relief engineers, 3 firemen, 1 relief fireman, 4 oilers, 3 screen men, 1 relief screen man, 3 helpers and 1 laborer.
Coal used: bituminous costing from $8.25 to $17.50 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the East Boston Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1920.						
January,	1,998,300,000	64,500,000	52,200,000	81,900,000	12.81	74,000,000
February,	2,039,300,000	70,300,000	55,000,000	96,300,000	12.89	68,800,000
March,	3,606,600,000	116,300,000	60,500,000	149,200,000	14.24	72,900,000
April,	2,998,400,000	99,900,000	66,200,000	142,600,000	13.95	80,000,000
May,	2,616,500,000	84,400,000	56,300,000	149,400,000	13.35	72,800,000
June,	2,713,500,000	90,500,000	72,800,000	147,800,000	13.56	77,200,000
July,	2,026,100,000	65,400,000	49,700,000	87,100,000	13.49	77,800,000
August,	1,543,000,000	49,800,000	40,200,000	65,200,000	12.96	60,800,000
September,	1,556,000,000	51,900,000	32,500,000	86,200,000	13.31	62,500,000
October,	1,457,200,000	47,000,000	37,300,000	70,100,000	13.30	70,200,000
November,	1,826,700,000	60,900,000	40,600,000	137,400,000	13.75	64,800,000
December,	1,972,000,000	63,600,000	49,400,000	98,000,000	13.65	67,600,000
Total,	26,353,600,000	–	–	–	–	–
Average,	–	72,000,000	51,100,000	109,300,000	13.44	70,800,000

Average Cost per Million Foot Gallons for Pumping at the East Boston Station.

Volume (26,353.6 Million Gallons) × Lift (13.44 Feet) = 354,192.4 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor,	$32,673 28	$0.09225
Coal,	39,911 76	0.11268
Oil,	1,168 27	0.00330
Waste,	117 97	0.00033
Water,	1,987 68	0.00561
Packing,	37 48	0.00011
Miscellaneous supplies and renewals,	2,152 35	0.00608
Totals,	$78,048 79	$0.22036
Labor at screens,	$2,226 50	–

Charlestown Pumping Station.

At this station are three submerged centrifugal pumps, two of them having impeller wheels 7.5 feet in diameter, the other 8.25 feet in diameter. They are driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 60,000,000 gallons with 8-foot lift.
Contract capacity of 2 pumps: 22,000,000 gallons each, with 11-foot lift.
Average duty for the year: 51,600,000 foot pounds.
Average quantity raised each day: 41,400,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 3 oilers, 3 screen men and 1 relief screen man.
Coal used: bituminous, costing from $8.25 to $17.50 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Charlestown Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1920.						
January,	1,182,500,000	38,100,000	30,100,000	46,200,000	7.98	55,600,000
February,	1,160,200,000	40,000,000	30,500,000	66,700,000	7.76	51,500,000
March,	1,921,400,000	62,900,000	35,700,000	73,300,000	6.74	65,000,000
April,	1,522,600,000	50,800,000	30,800,000	69,000,000	8.37	70,700,000
May,	1,459,800,000	47,100,000	31,100,000	73,500,000	7.67	59,800,000
June,	1,485,400,000	49,500,000	37,200,000	67,400,000	7.46	60,600,000
July,	1,092,400,000	35,400,000	27,800,000	49,800,000	6.65	40,300,000
August,	1,017,800,000	32,800,000	25,200,000	40,700,000	6.12	37,400,000
September,	1,028,800,000	34,300,000	23,400,000	56,600,000	7.58	50,800,000
October,	957,400,000	30,900,000	21,800,000	58,500,000	7.18	41,000,000
November,	1,094,800,000	36,500,000	23,700,000	68,500,000	7.42	45,600,000
December,	1,184,400,000	38,200,000	27,400,000	58,800,000	7.45	40,800,000
Total,	15,107,500,000	–	–	–	–	–
Average,	–	41,400,000	28,700,000	60,800,000	7.37	51,600,000

Average Cost per Million Foot Gallons for Pumping at the Charlestown Station.

Volume (15,107.5 Million Gallons) × Lift (7.37 Feet) = 111,342.3 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor,	$20,989 73	$0.18852
Coal,	14,462 45	0.12989
Oil,	504 94	0.00453
Waste,	24 48	0.00022
Water,	715 98	0.00643
Packing,	21 01	0.00019
Miscellaneous supplies and renewals,	312 11	0.00280
Totals,	$37,030 70	$0.33258
Labor at screens,	$3,594 44	-

Alewife Brook Pumping Station.

The plant at this station consists of two 9-inch Andrews commercial centrifugal pumps, direct connected by horizontal shafts to compound marine engines, together with a pump and engine added later. The latter consists of a specially designed engine of the vertical cross-compound type, having between the cylinders a centrifugal pump rotating on a horizontal axis.

Contract capacity of the 2 original pumps: 4,500,000 gallons each, with 13-foot lift.

Contract capacity of new pump: 13,000,000 gallons, with 13-foot lift.

Average duty for the year: 19,200,000 foot pounds.

Average quantity raised each day: 5,156,000 gallons.

Force employed: 3 engineers, 1 relief engineer, 3 screen men and 1 relief screen man.

Coal used: bituminous, costing from $8.80 to $18.51 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Alewife Brook Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1920.						
January,	122,651,000	3,956,000	3,622,000	4,260,000	13.08	15,200,000
February,	127,164,000	4,385,000	3,526,000	6,754,000	13.07	15,700,000
March,	298,110,000	9,616,000	4,260,000	16,000,000	13.10	26,600,000
April,	251,590,000	8,386,000	7,285,000	9,173,000	13.06	25,900,000
May,	228,728,000	7,378,000	6,076,000	9,350,000	13.00	24,400,000
June,	201,301,000	6,710,000	5,300,000	8,760,000	13.00	24,200,000
July,	140,429,000	4,530,000	4,376,000	6,518,000	12.92	19,400,000
August,	94,138,000	3,037,000	2,739,000	3,814,000	13.03	15,100,000
September,	88,814,000	2,960,000	2,503,000	4,318,000	13.05	15,000,000
October,	83,605,000	2,697,000	2,456,000	4,318,000	12.99	14,700,000
November,	105,261,000	3,509,000	2,456,000	7,816,000	13.02	16,200,000
December,	146,050,000	4,711,000	3,910,000	6,459,000	13.05	17,500,000
Total,	1,887,841,000	–	–	–	–	–
Average,	–	5,156,000	4,042,000	7,295,000	13.03	19,200,000

Average Cost per Million Foot Gallons for Pumping at the Alewife Brook Station.

Volume (1,887.841 Million Gallons) × Lift (13.03 Feet) = 24,598.57 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor,	$7,773 92	$0.31603
Coal,	6,276 89	0.25517
Oil,	370 62	0.01507
Waste,	138 53	0.00563
Water,	282 48	0.01149
Packing,	24 59	0.00100
Miscellaneous supplies and renewals,	489 84	0.01991
Totals,	$15,356 87	$0.62430
Labor at screens, oiling and miscellaneous services,	$4,575 33	–

South Metropolitan System.

Ward Street Pumping Station.

At this station are two vertical, triple-expansion pumping engines, of the Allis-Chalmers type, operating reciprocating pumps, the plungers of which are 48 inches in diameter with a 60-inch stroke.

Contract capacity of 2 pumps: 50,000,000 gallons each, with 45-foot lift.
Average duty for the year: 77,241,000 foot pounds.
Average quantity raised each day: 34,261,000 gallons.
Force employed: 4 engineers, 1 relief engineer, 4 firemen, 5 oilers, 4 assistant engineers, 1 machinist and 1 laborer.
Coal used: bituminous, costing from $8.10 to $19.48 per gross ton.
Material intercepted at screens during the year: 1,788.6 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Ward Street Pumping Station of the South Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal).
1920.						
January,	927,260,000	29,911,000	26,568,000	35,230,000	42.90	80,403,000
February,	886,185,000	30,558,000	27,351,000	40,121,000	42.67	75,840,000
March,	1,500,659,000	48,404,000	29,628,000	64,749,000	41.85	87,200,000
April,	1,301,307,000	43,377,000	38,717,000	47,345,000	41.49	82,132,000
May,	1,331,647,000	42,956,000	38,539,000	60,294,000	41.55	80,000,000
June,	1,289,867,000	42,996,000	36,473,000	54,753,000	41.00	82,751,000
July,	957,081,000	30,873,000	25,483,000	40,850,000	40.78	74,300,000
August,	793,845,000	25,607,000	22,347,000	33,684,000	41.68	69,638,000
September,	783,596,000	26,120,000	21,305,000	34,392,000	41.69	70,700,000
October,	772,490,000	24,919,000	22,805,000	35,153,000	41.85	68,870,000
November,	918,092,000	30,603,000	23,138,000	58,723,000	41.60	77,952,000
December,	1,078,947,000	34,804,000	29,710,000	47,551,000	41.32	77,107,000
Total,	12,540,976,000	–	–	–	–	–
Average,	–	34,261,000	28,505,000	46,070,000	41.70	77,241,000

Records from plunger displacements.

Average Cost per Million Foot Gallons for Pumping at the Ward Street Station.

Volume (12,540.976 Million Gallons) × Lift (41.70 Feet) = 522,958.70 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor,	$26,844 51	$0.05133
Coal,	35,474 76	0.06784
Oil,	620 51	0.00119
Waste,	80 32	0.00015
Water,	1,650 24	0.00316
Packing,	131 25	0.00025
Miscellaneous supplies and renewals,	4,509 95	0.00862
Totals,	$69,311 54	$0.13254
Labor at screens,	$6,940 18	–

Quincy Pumping Station.

At this station are two compound condensing Deane pumping engines and one Lawrence centrifugal pump driven by a Sturtevant compound condensing engine.

Contract capacity of 3 pumps: Deane, 3,000,000 gallons; Deane, 5,000,000 gallons; Lawrence centrifugal, 10,000,000 gallons.
Average duty for the year: 31,000,000 foot pounds.
Average quantity raised each day: 5,918,000 gallons.
Force employed: 3 engineers, 1 relief engineer, 3 screen men and 1 relief screen man.
Coal used: bituminous, costing from $8.80 to $19.05 per gross ton.
Material intercepted at screen during the year: 363 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Quincy Pumping Station of the South Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (Foot Pounds per 100 Pounds Coal)
1920.						
January,	127,399,000	4,110,000	3,717,000	4,642,000	23.13	28,500,000
February,	125,301,000	4,321,000	3,782,000	5,183,000	22.38	27,200,000
March,	335,003,000	10,807,000	4,405,000	16,627,000	29.06	37,800,000
April,	261,514,000	8,717,000	6,660,000	10,920,000	27.97	34,600,000
May,	258,391,000	8,335,000	5,830,000	12,974,000	31.38	37,500,000
June,	248,324,000	8,277,000	5,679,000	12,521,000	29.29	36,600,000
July,	153,588,000	4,954,000	4,205,000	5,947,000	25.03	30,100,000
August,	133,826,000	4,317,000	3,660,000	5,242,000	22.49	28,000,000
September,	114,676,000	3,823,000	3,390,000	4,195,000	21.81	27,300,000
October,	110,119,000	3,552,000	3,192,000	4,341,000	21.22	25,900,000
November,	127,072,000	4,236,000	3,151,000	6,313,000	22.71	28,200,000
December,	172,695,000	5,571,000	4,950,000	6,979,000	26.39	30,800,000
Total,	2,167,908,000	–	–	–	–	–
Average,	–	5,918,000	4,385,000	7,990,000	25.24	31,000,000

Average Cost per Million Foot Gallons for Pumping at the Quincy Station.

Volume (2,167.908 Million Gallons) × Lift (25.24 Feet) = 54,718.0 Million Foot Gallons.

Items.	Cost.	Cost per Million Foot Gallons.
Labor,	$8,005 41	$0.14630
Coal,	12,001 81	0.21934
Oil,	294 86	0.00539
Waste,	44 64	0.00082
Water,	407 62	0.00745
Packing,	43 93	0.00080
Miscellaneous supplies and renewals,	501 86	0.00917
Totals,	$21,300 13	$0.38927
Labor at screens, oiling and miscellaneous services,	$4,907 06	–

Nut Island Screen-house.

The plant at this house includes two sets of screens in duplicate actuated by small reversing engines of the Fitchburg type. Two vertical Deane boilers, 80 horse power each, operate the engines, provide heat and light for the house, burn materials intercepted at the screens, and furnish power for the Quincy (Hough's Neck) sewage lifting station.

Average daily quantity of sewage passing screens: 71,700,000 gallons.
Total material intercepted at screens: 1,187.0 cubic yards.
Material intercepted per million gallons of sewage discharged: 1.22 cubic feet.
Force employed: 3 engineers, 1 relief engineer, 3 screen men and 1 relief screen man.
Coal used: bituminous, costing $14.25 per gross ton.

Quincy (Hough's Neck) Sewage Lifting Station.

At this station are two 6-inch submerged Lawrence centrifugal pumps with vertical shafts actuated by two Sturtevant direct-current motors.

The labor and electric energy for this station are supplied from the Nut Island screen-house, and as used at present it does not materially increase the amount of coal used at the latter station. The effluent is largely ground water.

Contract capacity of 2 pumps: about 1,500,000 gallons each, with 20-foot lift.
Average daily amount pumped: 225,600 gallons.
Average lift: 14.93 feet.

Coal delivered in the Bins of the Sewerage Pumping Stations during the Year.

	Gross Tons, Bituminous Coal.							
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screen-house.	Price per Gross Ton.
Maritime Coaling Company,	400	–	–	–	–	–	–	$12 50
Maritime Coaling Company,	605	–	–	–	–	–	–	13 50
Maritime Coaling Company,	500	–	–	–	–	–	–	14 50
Maritime Coaling Company,	800	–	–	–	–	–	–	16 75
Maritime Coaling Company,	1,000	–	–	–	–	–	–	17 50
Furber Coal Company,	–	475	–	–	–	–	–	10 60
Maritime Coaling Company,	–	250	–	–	–	–	–	12 50
Metropolitan Coal Company,	–	177	–	–	–	–	–	13 25
Maritime Coaling Company,	–	600	–	–	–	–	–	14 00
Metropolitan Coal Company,	–	79	–	–	–	–	–	15 15
Maritime Coaling Company,	–	971	–	–	–	–	–	17 50
Maritime Coaling Company,	–	–	290	–	–	–	–	10 50
Maritime Coaling Company,	–	–	300	–	–	–	–	14 00
Metropolitan Coal Company,	–	–	58	–	–	–	–	15 12
Maritime Coaling Company,	–	–	300	–	–	–	–	17 50
Wm. A. Jepson Corp.,	–	–	–	78	–	–	–	9 50
Wm. A. Jepson Corp.,	–	–	–	80	–	–	–	10 01
Locke Coal Company,	–	–	–	34	–	–	–	13 25
Equitable Fuel Company,	–	–	–	117	–	–	–	14 35
Wm. A. Jepson Corp.,	–	–	–	103	–	–	–	15 08
Locke Coal Company,	–	–	–	77	–	–	–	16 03
New Eng. Coal & Coke Company,	–	–	–	52	–	–	–	18 51
Geo. E. Warren Company,	–	–	–	–	266	–	–	8 10
Batchelder Bros.,	–	–	–	–	193	–	–	8 79
Wm. A. Jepson Corp.,	–	–	–	–	215	–	–	9 56
Potts Run Coal Company,	–	–	–	–	72	–	–	9 85
Metropolitan Coal Company,	–	–	–	–	156	–	–	11 50
J. A. Whittemore's Sons,	–	–	–	–	129	–	–	11 75
Metropolitan Coal Company,	–	–	–	–	39	–	–	12 32
Equitable Fuel Company,	–	–	–	–	663	–	–	13 80
Metropolitan Coal Company,	–	–	–	–	256	–	–	15 72

Coal delivered in the Bins of the Sewerage Pumping Stations during the Year — Concluded.

	Gross Tons, Bituminous Coal.							
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screenhouse.	Price per Gross Ton.
Metropolitan Coal Company,	–	–	–	–	86	–	–	$16 24
Geo. E. Warren Company,	–	–	–	–	422	–	–	16 25
Geo. E. Warren Company,	–	–	–	–	41	–	–	17 38
Thomas J. McCue,	–	–	–	–	74	–	–	19 48
Geo. E. Warren Company,	–	–	–	–	–	32	–	8 80
Geo. E. Warren Company,	–	–	–	–	–	45	–	9 60
Wm. A. Jepson Corp.,	–	–	–	–	–	90	–	10 24
Wm. A. Jepson Corp.,	–	–	–	–	–	51	–	10 43
Equitable Fuel Company,	–	–	–	–	–	109	–	14 74
Metropolitan Coal Company,	–	–	–	–	–	44	–	15 05
Geo. E. Warren Company,	–	–	–	–	–	241	–	17 15
Geo. E. Warren Company,	–	–	–	–	–	106	–	18 15
J. F. Sheppard & Sons, Inc.,	–	–	–	–	–	22	–	19 05
Maritime Coaling Company,	–	–	–	–	–	–	400	14 25
Total bituminous,	3,305	2,552	948	541	2,612	740	400	–
Average cost,	$15 53	$14 49	$14 10	$13 70	$13 00	$14 75	$14 25	–

Metropolitan Sewerage Outfalls.

The metropolitan sewerage districts now have outfalls in Boston Harbor at five points, two of which may discharge sewage from the north district and three from the south district. These outfalls are all in good condition.

During the year the sewage of the north district has been discharged wholly through the outlet located near Deer Island light. The other outfall of this system is closed by a cast-iron cover which can be easily removed.

Of the outfalls of the south district, two extend for a distance exceeding 1 mile from the shore of Nut Island, Quincy, and the third one, called an emergency outlet, extends about 1,500 feet from

the same. During the flood period of March, 1920, all three of these outfalls were in operation. No discharge is made through the emergency outlet excepting at such flood periods.

An examination by diver was made of the metropolitan sewerage outfalls. Those on the south line were found to be clear of deposit and in excellent condition. The outfall near the Deer Island light is in good condition, but there was considerable deposit in the outer portion of the discharge pipes. One of the discharge openings was found to be entirely choked with grease. These obstacles were all removed. Evidently this type of outfall is going to need more attention than those designed originally.

During the year the average flow through the North Metropolitan District outfall at Deer Island has been 74,000,000 gallons of sewage per 24 hours, with a maximum rate of 151,200,000 gallons during a stormy period on March 17, 1920. The amount of sewage discharged in the North Metropolitan District averaged 129 gallons per day for each person, taking the estimated population of the district contributing sewage. If the sewers in this district were restricted to the admission of sewage proper only, this per capita amount would be considerably decreased.

In the South Metropolitan District an average of 71,700,000 gallons of sewage has passed daily through the screens at the Nut Island screen-house, and has been discharged from the outfalls into the outer harbor. The maximum rate of discharge per day which occurred during a heavy storm on March 13, 1920, was 234,000,000 gallons. The discharge of sewage through these outfalls represents the amount of sewage contributed by the South Metropolitan District, which was at the rate of 197 gallons per day per person of the estimated number contributing sewage in the district.

The daily discharge of sewage per capita is considerably larger in the South Metropolitan District than it is in the North Metropolitan District, because, owing to the large size and unused capacity of the south district high-level sewer, more storm water is at present admitted to the sewers of this district.

Material intercepted at the Screens.

The material intercepted at the screens at the North Metropolitan sewerage stations, consisting of rags, paper and other floating materials, has during the year amounted to 1,304.8 cubic yards. This

is equivalent to 1.301 cubic feet for each million gallons of sewage pumped at Deer Island.

The material intercepted at the screens at the South Metropolitan sewerage stations has amounted to 3,338.3 cubic yards, equal to 3.435 cubic feet per million gallons of sewage delivered at the outfall works at Nut Island.

Studies of sewage flows in the metropolitan sewers and siphons indicate that they are free from deposit.

FREDERICK D. SMITH,
Director and Chief Engineer.

Boston, January 1, 1921.

APPENDIX

Appendix No. 1.

Contracts made and pending during

[The details of contracts made before

	1. Number of Contract.	2. WORK.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	Amount of Bid. 5. Lowest.	6. Contractor.
1	393[1]	Furnishing 820 tons cast-iron water pipe; 90 tons 12-inch, 400 tons 16-inch and 330 tons 36-inch pipe and 25 tons special castings. (Contract also included 90 tons 16-inch pipe for Metropolitan Sewerage Works.)	5	$37,555 00[2]	$37,475 00	Warren Foundry & Machine Co., Phillipsburg, N. J.
2	1	Furnishing 2 vertical fire tube boilers for Chestnut Hill Pumping Station No. 1.	2	21,800 00	19,790 00[2]	D. M. Dillon Steam Boiler Works, Fitchburg, Mass.
3	2[1]	Resurfacing Massachusetts Avenue in Arlington for about 1,000 feet.	3	3,300 00	3,031 80[2]	John A. Gaffey, Medford, Mass.
4	3	Building and erecting pumping engine for Chestnut Hill Pumping Station No. 1.	2	86,600 00	75,900 00[2]	Worthington Pump and Machinery Corporation, New York.
5	4	Furnishing 35 kilowatt electric lighting unit for Chestnut Hill Pumping Station No. 2.	3	3,960 00	3,649 00[2]	Ames Iron Works, Oswego, N. Y.
6	5	Six street chambers for Venturi meter registers.	3	3,000 00	2,628 00[2]	Hodge Boiler Works, East Boston.
7	6[1]	Purchase and removal of used 35 h. p. Blake & Knowles pumping engine and 50 h. p. locomotive type boiler at sewerage pumping station in Clinton.	2	81 00[3]	287 50[2, 4]	H. Aronofsky & Sons, Boston.
8	7	Purchase and removal of three used 150 h. p. horizontal return tubular boilers at Chestnut Hill Pumping Station.	2	301 00[3]	500 00[2, 4]	Thomas Rush, Boston.
9	39-M	Sale and purchase of electric energy to be developed at Sudbury Dam in Southborough.	2	–[5]	–[5]	Edison Electric Illuminating Co. of Boston.

[1] Contract completed.

[2] Contract based upon this bid.

[3] Next to highest bid.

Appendix No. 1.

THE YEAR 1920 — WATER DIVISION.

1920 have been given in previous reports.]

7. Date of Contract.	8. Date of Completion of Contract.	9. Prices of Principal Items of Contracts.	10. Value of Work done Dec. 31, 1920.	
June 10, 1919	Aug. 3, 1920	See previous report, ...	$44,157 56	1
May 27, 1920	–	For whole work, $19,790, ...	–	2
June 11, 1920	July 17, 1920	For whole work, $3,031.80, ...	3,031 80	3
Oct. 29, 1920	–	For pumping engine with capacity of 15,000,000 United States gallons in 24 hours when operated at a plunger speed of not over 250 feet per minute against a head of 190 feet, and which when operated at said capacity against a head of 150 feet on duty trial shall perform a duty of 145,000,000 foot pounds for each 1,000 pounds of saturated steam supplied to the engine, $75,900.	–	4
Aug. 25, 1920	–	For 35 kilowatt, direct connected, steam engine driven center crank electric generating unit f. o. b. cars, Newton Center, $3,649.	1,600 00	5
Nov. 12, 1920	–	For each chamber, $438, ...	200 00	6
Dec. 4, 1920	Dec. 18, 1920	For used engine and boiler, $287.50, ...	287 50	7
Dec. 22, 1920	–	For three used boilers, $500, ...	–	8
Dec. 21, 1914	Jan. 1, 1922	About 5,000,000 kilowatt hours of energy per year at $6.25 per thousand kilowatt hours.	139,447 14	9

[4] Highest bid.

[5] Contract based upon bid of $6.25 per thousand kilowatt hours for entire output. Other bid for portion of output.

CONTRACTS MADE AND PENDING DURING

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	AMOUNT OF BID. 5. Lowest.	6. Contractor.
10	51–M	Sale and purchase of electric energy to be developed at Washusett Dam in Clinton.	1	–	$5.30 per M kilowatt hours.	New England Power Co. and Edison Electric Illuminating Co. of Boston.
11	64–M[6]	8,000 tons bituminous coal,	4 under W. W. Specifications. 3 under Dealers' Specifications.	$3.25 per gr. ton.	$3.09[2] per gr. ton.	George E. Warren Co., Boston.
12	1–M[1]	Repairs to Green fuel economizer at Spot Pond Pumping Station.	–	–[7]	–[7]	Green Fuel Economizer Co., Beacon, N. Y.
13	2–M[1]	Shaking and dumping grate for Chestnut Hill Pumping Station.	–	–[7]	–[7]	Perfection Grate and Supply Co., Springfield, Mass.
14	3–M[1]	Demolition of chimney at Mystic Pumping Station in West Somerville.	3	$2,835 00	$1,400 00[2]	Thomas A. Elston Co., Inc., Boston.

[1] Contract completed.

[2] Contract based upon this bid.

THE YEAR 1920 — WATER DIVISION — *Continued.*

7. Date of Contract.	8. Date of Completion of Contract.	9. Prices of Principal Items of Contracts.	10. Value of Work done Dec. 31, 1920.	
Jan. 13, 1917	Jan. 1, 1929	About 7,000,000 kilowatt hours of energy per year at $5.30 per thousand kilowatt hours.	$90,313 75	10
May 7, 1919	April 19, 1920	See previous report.	20,980 48	11
Jan. 13, 1920	Aug. 16, 1920	For whole work, $3,388, ...	3,388 00	12
July 15, 1920	Dec. 31, 1920	For grate, $9.50 per sq. ft.; ring for 84-inch boiler, $35; and for repair parts for existing grate, $92.69.	1,011 19	13
Aug. 28, 1920	Nov. 17, 1920	For whole work, $1,400, ...	1,365 31	14

[6] About 1,800 tons shipped between Nov. 17, 1919, and April 9, 1920, were diverted by United States Railroad Administration. Feb. 2, 1920, dealer increased price to $3.10 net ton, and April 9 again increased price to $5 net ton.

[7] Competitive bids were not received.

CONTRACTS MADE AND PENDING DURING THE YEAR 1920 — WATER DIVISION — *Concluded.*

Summary of Contracts, 1895 to 1920, inclusive. [1]

	Value of Work done Dec. 31, 1920.
Distribution Section, 3 contracts,	$47,389 36
Pumping Service, 3 contracts,	1,600 00
	$48,989 36
401 contracts completed from 1896 to 1919, inclusive,	17,606,480 43
	$17,655,469 79
Deduct for work done on 11 Sudbury Reservoir contracts by the city of Boston,	512,000 00
Total of 407 contracts,	$17,143,469 79

[1] In this summary contracts for the sale of used material and contracts charged to maintenance are excluded.

Appendix No. 2.

Table No. 1. — *Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, 1920.*

	Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
Wachusett Watershed.	Princeton,	2.75	5.90	3.92	6.14	3.54	4.92	5.10	4.21	6.02	0.62	5.00	5.37	53.49
	Jefferson,	3.67	7.33	5.10	6.52	3.54	6.61	4.84	2.56	6.32	0.70	5.38	6.32	58.89
	Sterling,	3.17	5.77	3.87	6.26	4.11	6.36	4.53	2.92	7.07	0.67	5.76	6.35	56.84
	Boylston,	3.07	6.04	4.16	5.59	4.86	6.40	2.85	1.93	6.17	0.53	5.83	6.00	53.43
Sudbury Watershed.	Sudbury Dam,	3.06	6.15	4.72	5.12	3.27	7.23	1.97	1.57	3.62	0.88	5.75	4.98	48.32
	Framingham,	3.29	6.89	4.72	5.23	3.75	7.18	1.88	1.78	3.35	1.02	5.92	5.32	50.33
	Ashland Dam,	3.17	6.47	3.99	5.01	3.32	5.67	2.33	2.29	3.29	1.20	5.23	4.74	46.71
	Cordaville,	3.51	6.44	4.39	5.41	3.44	6.62	1.96	1.46	3.87	0.92	5.84	5.41	49.27
Lake Cochituate,		3.25	7.01	4.28	5.61	2.96	7.73	1.81	1.58	3.88	1.21	5.96	5.47	50.75
Chestnut Hill Reservoir,		3.67	7.16	4.16	6.10	4.78	6.26	1.76	1.75	3.12	1.23	6.09	4.48	50.56
Spot Pond,		3.18	7.70	4.16	5.74	4.98	7.15	1.88	1.37	3.50	1.12	5.53	4.70	51.01
Average of all,		3.25	6.62	4.32	5.70	3.87	6.56	2.81	2.13	4.56	0.92	5.66	5.38	51.78
Average, Wachusett watershed,		3.17	6.26	4.26	6.13	4.01	6.07	4.33	2.91	6.39	0.63	5.49	6.01	55.66
Average, Sudbury watershed,		3.26	6.49	4.45	5.19	3.45	6.67	2.04	1.78	3.53	1.01	5.68	5.11	48.66

TABLE NO. 2. — *Rainfall in Inches at Jefferson, Mass., in 1920.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	–	–	–	–	–	–	–	–	–	–	–	[3]
2,	–	–	–	0.80[2]	–	–	–	–	–	–	[3]	0.78[2]
3,	–	–	–	–	[3]	–	1.01	–	–	–	1.10	[3]
4,	–	[3]	–	[3]	0.45[2]	–	–	–	–	–	–	0.12[2]
5,	–	[3]	[3]	1.00[2]	–	2.50	–	–	–	0.05	–	1.74
6,	–	[3]	2.67[2]	–	–	–	–	–	–	–	–	–
7,	–	3.20[2]	–	0.31[1]	–	–	–	–	–	–	–	–
8,	[3]	–	–	–	0.92	–	–	–	–	–	–	–
9,	1.36[2]	–	–	–	–	–	–	–	–	–	–	[3]
10,	–	0.75[1]	–	–	–	–	–	–	1.16	–	–	0.15[2]
11,	–	–	–	–	–	–	–	–	–	–	–	–
12,	–	–	[3]	[3]	–	[3]	0.51	1.25	0.06	–	–	–
13,	0.10[1]	0.39[1]	1.00	0.92	0.09	0.12	–	–	0.41[2]	–	–	[3]
14,	–	–	–	–	0.08	–	–	0.26	–	–	–	2.17
15,	–	1.20[2]	–	–	–	0.06	0.84	–	–	–	–	–
16,	[3]	–	0.16	–	–	[3]	–	0.30	0.05	–	[3]	–
17,	0.67[1]	–	–	–	–	[3]	–	–	–	–	1.84[2]	–
18,	–	–	–	–	–	3.08	[3]	0.25	–	–	–	–
19,	0.36[1]	0.61[1]	[3]	–	–	–	1.25	–	–	–	–	–
20,	–	–	0.96[1]	–	–	–	–	–	–	–	–	–
21,	–	–	–	[3]	[3]	0.38	–	–	–	–	[3]	–
22,	–	0.47[1]	–	[3]	[3]	0.37	–	–	–	–	[3]	[3]
23,	[3]	[3]	–	1.85	2.00	–	[3]	–	–	–	2.24	0.43[2]
24,	[3]	0.31[2]	–	–	–	–	0.55	–	–	–	–	–
25,	0.80[2]	0.40[2]	–	–	–	–	0.45	–	–	–	0.20[1]	–
26,	–	–	0.14	–	–	–	–	–	–	–	–	[3]
27,	0.10	–	–	[3]	–	–	–	–	[3]	[3]	–	0.93[2]
28,	0.28[1]	–	–	1.61	–	–	–	–	0.73	0.65	–	–
29,	–	–	0.17	–	–	0.10	–	–	–	–	–	–
30,	–	–	–	–	–	–	–	0.25	[3]	–	–	–
31,	–	–	–	0.03	–	–	0.23	0.25	3.91	–	–	–
Totals,	3.67	7.33	5.10	6.52	3.54	6.61	4.84	2.56	6.32	0.70	5.38	6.32

Total for the year, 58.89 inches.

[1] Snow. [2] Rain and snow. [3] Rainfall included in that following.

TABLE No. 3. — *Rainfall in Inches at Framingham, Mass., in 1920.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	–	–	–	[3]	0.03	–	–	[3]	0.06	–	–	0.63
2,	–	–	–	0.84	[3]	–	–	0.03	–	–	[3]	–
3,	–	–	–	–	0.30	–	0.82	–	–	–	0.86	[3]
4,	–	–	–	[3]	0.41	[3]	–	–	–	–	–	[3]
5,	–	[3]	[3]	0.61[2]	–	[3]	–	–	–	0.01	–	1.11
6,	–	[3]	2.08[2]	[3]	–	2.40	–	[3]	[3]	–	–	–
7,	–	2.86[2]	–	0.25[1]	–	–	–	0.38	0.13	–	0.03	–
8,	[3]	–	–	–	0.61	–	–	–	–	–	–	[3]
9,	1.16[1]	–	–	–	–	–	0.04	–	[3]	–	0.02	[3]
10,	–	0.30[2]	–	–	0.07	–	–	[3]	1.06	–	–	[3]
11,	–	–	–	–	0.06	–	0.01	0.35	–	–	–	0.27
12,	[3]	–	[3]	–	[3]	[3]	0.06	–	[3]	0.03	–	–
13,	0.08[1]	0.73[1]	1.11	0.65	0.16	0.07	–	[3]	0.44	–	–	[3]
14,	–	[3]	–	–	0.38	–	–	0.11	0.01	–	–	1.78
15,	–	0.80	–	–	0.13	0.29	0.20	–	–	–	–	–
16,	[3]	–	[3]	0.02	–	[3]	–	0.15	0.02	–	[3]	–
17,	0.56[1]	–	0.17	–	–	[3]	–	0.03	–	–	2.21	–
18,	–	[3]	–	–	–	2.88	[3]	0.02	0.02	–	–	–
19,	0.15[1]	0.94[2]	[3]	–	–	–	0.25	–	–	–	–	–
20,	0.18[1]	–	0.92[2]	[3]	–	[3]	–	–	–	–	–	–
21,	–	[3]	–	[3]	[3]	0.66	–	0.01	–	–	[3]	–
22,	–	0.32[1]	–	[3]	[3]	0.85	–	0.20	–	–	[3]	[3]
23,	[3]	[3]	–	1.62	[3]	–	–	–	–	–	2.52	0.62
24,	[3]	[3]	–	–	1.60	–	0.43	–	–	–	[3]	–
25,	0.87[2]	0.90[2]	[3]	–	–	–	–	–	–	–	0.23	–
26,	[3]	–	0.21	–	–	–	–	–	–	[3]	–	[3]
27,	[3]	–	–	[3]	–	–	–	–	[3]	[3]	[3]	0.91
28,	0.29[2]	0.04[1]	–	1.11	–	0.01	–	–	0.14	0.97	0.05	–
29,	–	–	0.23	–	–	0.01	–	0.03	–	0.01	–	–
30,	–	–	–	[3]	–	0.01	–	0.10	[3]	–	–	–
31,	–	–	–	0.13	–	–	0.07	0.37	1.47	–	–	–
Totals,	3.29	6.89	4.72	5.23	3.75	7.18	1.88	1.78	3.35	1.02	5.92	5.32

Total for the year, 50.33 inches.

[1] Snow. [2] Rain and snow. [3] Rainfall included in that following.

TABLE NO. 4. — *Rainfall in Inches at Chestnut Hill Reservoir, 1920.*

DATE.	Amount.	Duration.
Jan. 9,	1.10[1]	3.00 A.M. to 11.30 P.M.
Jan. 13,	.12[1]	5.15 A.M. to 1.45 P.M.
Jan. 16,	.78[1]	9.00 P.M. to
Jan. 17,		10.45 A.M.
Jan. 19,	.18[1]	4.45 P.M. to 10.30 P.M.
Jan. 20,	.18[2]	8.10 P.M. to
Jan. 21,		3.00 A.M.
Jan. 23,	.04[1]	12.30 A.M. to 7.30 A.M.
Jan. 23,	.48[1]	4.15 P.M to
Jan. 24,		4.30 A.M.
Jan. 24,	.47[1]	10.15 A.M. to
Jan. 25,		2.45 P.M.
Jan. 27,	.16	8.30 A.M. to 11.45 A.M.
Jan. 28,	.16[1]	7.00 A.M. to 4.00 P.M.
Total,	3.67	
Feb. 5,	2.51[2]	2.10 A.M. to
Feb. 6,		2.15 A.M.
Feb. 6,	.89[2]	9.30 A.M. to
Feb. 7,		2.45 A.M.
Feb. 10,	.19[2]	8.30 A.M. to 7.00 P.M.
Feb. 13,	.55[1]	6.45 A.M. to 7.00 P.M.
Feb. 15,	.89	3.30 A.M. to 10.30 A.M.
Feb. 19.	.78[2]	3.30 A.M. to 3.45 P.M.
Feb. 21,	.30[1]	9.45 P.M. to
Feb. 22,		6.30 A.M.
Feb. 23,	.96[2]	7.00 P.M. to
Feb. 25,		10.00 A.M.
Feb. 28,	.09[1]	8.00 P.M. to
Feb. 29,		1.45 A.M.
Total,	7.16	
Mar. 5,	1.17[2]	8.30 P.M. to
Mar. 6,		8.00 A.M.
Mar. 6,	.14[1]	8.00 A.M. to 3.30 P.M.
Mar. 13,	1.27	6.15 A.M. to 8.20 P.M.
Mar. 16,	.15	1.15 P.M. to
Mar. 17,		1.30 A.M.
Mar. 19,	1.02[1]	6.45 P.M. to
Mar. 20,		6.00 P.M.
Mar. 25,	.08	6.30 P.M. to
Mar. 26,		7.00 A.M.
Mar. 26,	.05	11.00 P.M. to
Mar. 27,		2.30 A.M.
Mar. 29,	.28	10.45 A.M. to 10.45 P.M.
Total,	4.16	
Apr. 2,	.87	1.20 A.M. to
Apr. 3,		1.45 A.M.
Apr. 4,	.87[2]	12.20 P.M. to
Apr. 5,		8.40 P.M.
Apr. 7,	.25[2]	3.00 A.M. to 4.00 P.M.
Apr. 12,	.59	11.30 P.M. to
Apr. 14,		7.00 A.M.
Apr. 16,	.04	1.30 A.M. to 2.00 P.M.
Apr. 21,	1.04	4.30 A.M. to
Apr. 22,		4.00 P.M.
Apr. 23,	1.05	5.15 A.M. to
Apr. 24,		3.45 A.M.
Apr. 27,	1.23	8.00 P.M. to
Apr. 28,		3.00 P.M.
Apr. 29,	.04	6.30 P.M. to 6.45 P.M.
Apr. 30,	.12	5.15 A.M. to
May 1,		9.15 P.M.
Total,	6.10	
May 2,	.82	11.30 A.M. to
May 4,		1.00 P.M.
May 8,	.78	11.45 A.M. to
May 9,		4.30 A.M.
May 10,	.05	4.30 P.M. to 5.45 P.M.
May 11,	.07	8.00 A.M. to 8.30 P.M.
May 13,	.18	4.45 A.M. to 1.30 P.M.
May 14,	.22	1.40 P.M. to
May 15,		2.00 A.M.
May 15,	.07	1.00 P.M. to 1.40 P.M.
May 21,	2.59	3.45 P.M. to
May 24,		1.00 A.M.
Total,	4.78	
June 5,	2.45	2.15 A.M. to
June 6,		3.15 A.M.
June 13,	.04	6.15 A.M. to 4.00 P.M.
June 15,	.67	2.40 P.M. to
June 16,		3.15 A.M.
June 16,	2.46	10.00 A.M. to
June 19,		2.15 A.M.
June 21,	.43	4.00 A.M. to
June 22,		4.30 A.M.
June 22,	.14	4.20 P.M. to 7.00 P.M.
June 28,	.05	5.15 P.M. to
June 29,		3.00 A.M.
June 30,	.02	10.00 A.M. to 11.30 A.M.
Total,	6.26	
July 3,	.69	10.00 A.M. to 8.30 P.M.
July 9,	.04	11.30 P.M. to
July 10,		12.30 A.M.
July 11,	.10	11.15 P.M. to
July 12,		8.00 P.M.
July 15,	.29	12.25 P.M. to 9.00 P.M.
July 18,	.20	5.30 P.M. to
July 19,		10.30 A.M.
July 22,	.02	4.20 A.M. to 4.30 A.M.
July 24,	.18	1.30 A.M. to 6.00 A.M.
July 24,	.24	3.25 P.M. to 10.00 P.M.
Total,	1.76	
Aug. 2,	.04	4.00 A.M. to 6.30 A.M.
Aug. 2	.03	11.00 P.M. to
Aug. 3,		2.30 A.M.
Aug. 7,	.28	4.50 A.M. to 7.30 A.M.
Aug. 7.	.52	3.00 P.M. to 6.00 P.M.
Aug. 8,	.07	3.00 P.M. to 4.30 P.M.
Aug. 11,	.18	2.15 A.M. to
Aug. 12,		7.00 A.M.
Aug. 13,	.10	9.40 A.M. to
Aug. 14,		8.00 A.M.
Aug. 15,	.03	3.45 A.M. to 6.30 A.M.
Aug. 16,	.07	6.30 P.M. to 9.45 P.M.
Aug. 18,	.02	12.15 A.M. to 10.30 A.M.
Aug. 22,	.17	1.15 A.M. to 2.00 P.M.
Aug. 29,	.03	4.15 P.M. to 6.00 P.M.
Aug. 31,	.21	3.10 P.M. to 4.30 P.M.
Total,	1.75	

[1] Snow. [2] Rain and snow

TABLE No. 4. — *Rainfall in Inches at Chestnut Hill Reservoir, 1920* — Concluded.

DATE.	Amount.	Duration.
Sept. 1, . .	.04	7.45 A.M. to 8.15 A.M.
Sept. 6, . .	.06	11.30 P.M. to
Sept. 7, . .		9.00 A.M.
Sept. 7, . .	.12	7.25 P.M. to 8.15 P.M.
Sept. 10, .	.94	4.15 A.M. to
Sept. 11, .		7.30 A.M.
Sept. 12, .	.04	3.30 A.M. to 7.30 A.M.
Sept. 12, .	.15	11.00 P.M. to
Sept. 13, .		1.15 A.M.
Sept. 13, .	.16	9.30 A.M. to 11.00 P.M.
Sept. 14, .	.08	4.40 P.M. to
Sept. 15, .		7.00 A.M.
Sept. 16, .	.05	4.35 P.M. to 6.30 P.M.
Sept. 19, .	.06	12.15 A.M. to 4.15 A.M.
Sept. 28, .	.13	8.30 P.M. to
Sept. 29, .		1.30 A.M.
Sept. 30, .	1.29	3.15 A.M. to
Oct. 1, . .		7.30 A.M.
Total, .	3.12	
Oct. 1, . .	.04	7.30 A.M. to 1.10 A.M.
Oct. 5, . .	.03	12.15 P.M. to 1.40 P.M.
Oct. 11, . .	.03	11.20 P.M. to
Oct. 12, . .		3.00 A.M.
Oct. 21, . .	.02	5.15 A.M. to 6.00 A.M.
Oct. 27, . .	.14	3.45 A.M. to 4.00 A.M.
Oct. 27, . .	.97	10.30 P.M. to
Oct. 29, . .		6.00 A.M.
Total, .	1.23	
Nov. 2, . .	.91	9.45 P.M. to
Nov. 3, . .		4.00 A.M.
Nov. 7, . .	.04	4.40 P.M. to
Nov. 8, . .		4.00 A.M.
Nov. 9, . .	.02	4.40 P.M. to 6.00 P.M.
Nov. 16, .	2.07	2.20 P.M. to
Nov. 17, .		5.30 P.M.
Nov. 21, .	.12[1]	4.30 A.M. to 12.30 P.M.
Nov. 21, .	2.71	12.30 P.M. to
Nov. 24, .		2.15 A.M.
Nov. 24, .	.16[2]	10.15 P.M. to
Nov. 25, .		7.15 P.M.
Nov. 27, .	.06[2]	6.00 P.M. to
Nov. 28, .		11.00 P.M.
Total, .	6.09	
Dec. 1, . .	.55	8.00 A.M. to 12.00 M.
Dec. 3, . .	.18[2]	9.00 P.M. to
Dec. 4, . .		7.00 A.M.
Dec. 4, . .	.83	7.00 P.M. to
Dec. 5, . .		9.45 P.M.
Dec. 9, . .	.10[1]	3.30 A.M. to 2.45 P.M.
Dec. 9, . .	.25	6.00 P.M. to
Dec. 10, .		7.00 A.M.
Dec. 13, .	1.29	10.15 P.M. to
Dec. 14, .		7.00 P.M.
Dec. 15, .	.05	2.30 P.M. to 3.15 P.M.
Dec. 22, .	.47	9.15 P.M. to
Dec. 23, .		7.15 A.M.
Dec. 27, .	.47[1]	2.00 A.M. to 11.45 A.M.
Dec. 27, .	.29[2]	11.45 A.M. to 11.00 P.M.
Total, .	4.48	

Total for the year, 50.56 inches.

[1] Snow. [2] Rain and snow.

TABLE No. 5. — *Rainfall in Inches on the Wachusett Watershed,*[1] *1897 to 1920.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1897,	3.46	2.86	4.01	2.32	5.06	5.11	8.65	3.47	1.93	0.94	7.62	6.41	51.84
1898,	6.65	3.30	2.27	4.43	3.38	3.11	3.01	10.61	3.15	7.21	6.81	3.99	57.92
1899,	2.93	5.12	6.75	1.94	1.33	5.51	3.82	3.20	4.11	2.72	1.94	2.03	41.40
1900,	4.56	8.69	6.19	2.76	4.34	3.59	3.20	3.18	3.46	2.90	6.44	3.15	52.46
1901,	1.75	1.13	5.82	9.64	7.02	1.51	5.66	4.58	3.10	3.70	2.43	9.36	55.70
1902,	2.72	4.91	5.27	4.36	2.24	2.51	3.87	3.95	4.26	6.36	0.93	7.20	48.58
1903,	2.85	4.42	6.58	3.10	1.24	10.37	3.43	3.88	2.93	4.43	2.36	3.99	49.58
1904,	4.02	2.66	3.40	7.45	2.99	3.44	3.84	3.68	5.30	1.78	1.62	2.88	43.06
1905,	6.10	1.72	3.95	2.60	0.83	4.88	5.39	3.09	6.90	1.81	2.52	3.79	43.58
1906,	2.59	2.74	5.17	3.12	6.58	5.95	5.52	4.34	2.61	3.95	2.25	4.26	49.08
1907,	2.84	2.32	1.82	2.65	2.96	3.54	3.03	1.26	9.50	5.68	5.74	4.40	45.74
1908,	3.40	4.82	2.77	2.62	5.34	1.29	3.85	6.49	1.04	2.13	1.05	3.03	37.83
1909,	3.52	6.10	4.38	5.71	2.65	3.03	4.25	3.59	3.90	1.70	1.68	3.99	44.50
1910,	5.86	5.24	1.09	3.01	2.13	4.36	1.52	3.87	2.86	1.40	4.17	2.34	37.85
1911,	2.91	2.43	3.79	2.22	1.59	2.37	2.53	5.46	3.04	5.24	4.14	3.01	38.73
1912,	2.57	2.42	5.69	4.06	5.76	0.48	2.65	2.89	2.17	2.53	4.02	4.95	40.19
1913,	3.38	2.55	5.58	3.90	3.71	0.90	2.37	3.05	4.44	6.02	2.59	2.73	41.22
1914,	3.40	3.58	4.33	4.91	3.01	2.00	3.92	4.50	0.15	1.88	2.97	3.89	38.54
1915,	6.31	3.32	0.06	1.80	1.67	3.18	8.60	6.90	1.53	3.05	3.12	5.11	44.65
1916,	1.60	5.98	3.32	3.65	3.34	6.57	5.66	1.72	4.21	1.42	3.15	2.81	43.43
1917,	3.37	3.05	4.21	1.80	3.89	4.47	1.22	4.46	1.20	6.03	1.25	2.31	37.26
1918,	2.97	4.25	2.24	3.47	1.07	4.57	2.80	2.82	7.18	1.58	3.08	3.74	39.77
1919,	3.23	3.51	5.27	2.57	6.06	2.01	5.00	4.17	6.78	2.35	6.01	2.09	49.05
1920,	3.17	6.26	4.26	6.13	4.01	6.07	4.33	2.91	6.39	0.63	5.49	6.01	55.66
Totals,	86.16	93.38	98.22	90.22	82.20	90.82	98.12	98.07	92.14	77.44	83.38	97.47	1,087.62
Average (24 years),	3.59	3.89	4.09	3.76	3.43	3.78	4.09	4.09	3.84	3.23	3.47	4.06	45.32

[1] Means of observations at four places, as follows: January, 1897, to December, 1900, Princeton, Jefferson, Sterling and South Clinton; January, 1901, to December, 1916, Princeton, Jefferson, Sterling and Boylston.

TABLE NO. 6. — *Rainfall in Inches on the Sudbury Watershed,*[1] *1875–1920.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875,	2.42	3.15	3.74	3.23	3.56	6.24	3.57	5.53	3.43	4.85	4.83	0.94	45.49
1876,	1.83	4.21	7.43	4.20	2.76	2.04	9.13	1.72	4.62	2.24	5.76	3.62	49.56
1877,	3.22	0.74	8.36	3.43	3.70	2.43	2.95	3.68	0.32	8.52	5.80	0.87	44.02
1878,	5.63	5.97	4.69	5.79	0.96	3.88	2.97	6.94	1.29	6.42	7.02	6.37	57.93
1879,	2.48	3.56	5.14	4.72	1.58	3.79	3.93	6.51	1.88	0.81	2.68	4.34	41.42
1880,	3.57	3.98	3.31	3.11	1.84	2.14	6.27	4.01	1.60	3.74	1.78	2.83	38.18
1881,	5.56	4.65	5.73	2.00	3.51	5.39	2.35	1.36	2.62	2.95	4.09	3.96	44.17
1882,	5.95	4.55	2.65	1.82	5.07	1.66	1.77	1.67	8.74	2.07	1.15	2.30	39.40
1883,	2.81	3.87	1.78	1.84	4.19	2.40	2.68	0.73	1.52	5.60	1.81	3.55	32.78
1884,	5.09	6.54	4.72	4.41	3.47	3.44	3.67	4.65	0.85	2.48	2.65	5.17	47.14
1885,	4.71	3.87	1.07	3.60	3.48	2.87	1.43	7.18	1.43	5.09	6.09	2.72	43.54
1886,	6.36	6.28	3.61	2.22	3.00	1.47	3.27	4.10	2.90	3.24	4.64	4.97	46.06
1887,	5.20	4.78	4.90	4.27	1.16	2.65	3.76	5.28	1.32	2.83	2.67	3.88	42.70
1888,	4.15	3.68	6.02	2.43	4.82	2.54	1.41	6.22	8.59	4.99	7.22	5.40	57.47
1889,	5.37	1.65	2.37	3.41	2.95	2.80	8.94	4.18	4.60	4.25	6.29	3.14	49.95
1890,	2.53	3.51	7.73	2.64	5.21	2.03	2.46	3.87	6.00	10.51	1.20	5.31	53.00
1891,	7.02	5.23	6.48	3.91	2.01	3.77	3.39	4.73	2.38	3.83	3.09	3.68	49.52
1892,	5.85	3.14	4.06	0.83	5.58	2.76	4.23	4.44	2.84	1.17	5.80	1.13	41.83
1893,	2.92	8.20	3.67	3.60	6.61	2.38	2.57	5.41	1.74	4.07	2.20	4.86	48.23
1894,	4.09	3.91	1.43	3.42	4.24	1.15	3.26	2.03	2.63	5.34	3.43	4.81	39.74
1895,	4.06	1.39	2.98	5.25	2.02	2.77	5.04	4.15	2.30	10.68	6.63	3.35	50.62
1896,	2.39	7.18	5.24	1.57	2.57	3.22	2.51	2.40	7.72	3.76	3.02	2.12	43.70
1897,	4.00	2.91	3.66	2.82	4.37	4.46	5.44	3.51	2.94	0.47	6.40	5.21	46.19
1898,	6.83	4.49	2.40	4.66	3.22	2.48	4.09	8.17	2.62	6.71	6.93	3.28	55.88
1899,	4.18	4.91	7.01	1.90	1.45	2.51	3.22	1.43	3.95	2.69	2.18	1.78	37.21
1900,	4.96	9.14	6.35	2.58	4.32	2.99	2.42	2.26	3.36	3.83	5.70	2.74	50.65

[1] See note at end of this table.

TABLE No. 6. — *Rainfall in Inches on the Sudbury Watershed,*[1] *1875–1920* — Concluded.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1901,	1.82	1.52	6.57	8.60	7.23	1.38	5.71	4.57	3.30	2.82	2.90	9.69	56.11
1902,	2.52	6.18	5.34	4.13	1.86	2.89	2.94	3.40	4.54	4.44	1.45	6.38	46.07
1903,	3.80	3.95	6.63	2.99	0.93	9.25	2.77	3.67	1.75	4.72	1.56	3.14	45.16
1904,	4.87	3.00	2.72	8.87	2.65	2.80	1.96	3.86	5.80	1.64	1.73	2.92	42.82
1905,	5.26	2.20	3.15	2.72	1.31	5.00	5.47	2.70	6.88	1.54	2.07	4.01	42.31
1906,	2.47	2.92	6.32	2.88	5.66	3.91	3.42	3.02	3.30	3.40	2.69	4.49	44.48
1907,	3.28	2.17	1.91	3.41	3.63	3.53	1.86	1.07	8.76	4.17	6.12	4.47	44.38
1908,	3.60	4.56	3.82	1.88	5.51	0.86	3.71	4.57	0.97	2.55	0.98	3.14	36.15
1909,	3.98	5.79	4.26	4.67	2.43	2.81	1.59	2.93	4.74	1.12	3.38	4.05	41.75
1910,	5.39	5.06	0.85	2.75	1.29	4.68	2.03	2.62	2.49	1.86	4.13	2.49	35.64
1911,	2.88	2.77	3.59	2.81	1.01	2.53	3.19	4.94	2.75	3.69	4.62	3.60	38.38
1912,	2.94	2.77	6.46	4.37	4.55	0.46	3.24	3.05	1.76	2.35	3.64	5.13	40.72
1913,	3.17	2.82	5.75	4.25	3.97	1.98	3.60	3.64	3.77	5.53	2.65	3.18	44.31
1914,	3.85	4.07	4.57	5.10	3.08	1.90	3.44	3.82	0.29	1.60	2.53	3.46	37.71
1915,	6.51	3.58	0.05	2.48	1.74	3.65	8.12	5.87	1.10	2.95	2.79	5.09	43.93
1916,	1.53	5.91	4.16	4.19	3.43	4.77	5.17	2.01	1.80	1.49	2.28	3.22	39.96
1917,	3.50	2.68	4.96	2.41	4.93	4.23	1.11	6.40	1.52	5.65	1.31	2.81	41.51
1918,	3.47	3.58	2.50	4.43	1.16	3.65	4.07	1.61	8.60	1.04	2.75	3.68	40.54
1919,	3.52	3.40	4.79	2.93	4.60	1.86	5.47	3.75	5.28	2.16	5.90	1.98	45.64
1920,	3.26	6.49	4.45	5.19	3.45	6.67	2.04	1.78	3.53	1.01	5.68	5.11	48.66
Totals,	184.80	190.91	199.38	164.72	152.07	145.07	167.64	175.44	157.12	168.87	172.22	174.37	2,052.61
Average (46 years),	4.02	4.15	4.33	3.58	3.31	3.15	3.64	3.81	3.42	3.67	3.75	3.79	44.62

[1] Means of observations at several places, as follows: January, 1875, to March, 1876, inclusive, Lake Cochituate; April and May, 1876, Lake Cochituate, Westborough and Hopkinton; June to November, 1876, inclusive, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to December, 1882, inclusive, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to December, 1889, inclusive, Framingham and Westborough; January, 1890, to May, 1898, inclusive, Framingham and Ashland Dam; since June, 1898, Framingham, Ashland Dam, Cordaville and Sudbury Dam.

TABLE No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile,*[1] *1897–1920.*

MONTH.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
January,	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000	1,265,000	659,000	1,266,000	1,132,000	1,458,000	1,738,000
February,	931,000	1,635,000	1,090,000	4,054,000	356,000	1,401,000	2,133,000	927,000	452,000	1,027,000	692,000	1,736,000
March,	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000	3,423,000	3,008,000	3,004,000	1,860,000	1,697,000	2,192,000
April,	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,159,000	2,238,000	2,984,000	1,617,000	2,109,000	1,436,000	1,269,000
May,	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000	569,000	1,498,000	445,000	1,533,000	965,000	1,415,000
June,	1,181,000	828,000	561,000	578,000	985,000	410,000	2,131,000	762,000	542,000	1,184,000	773,000	403,000
July,	1,442,000	333,000	354,000	217,000	477,000	292,000	624,000	497,000	365,000	728,000	335,000	220,000
August,	896,000	1,325,000	236,000	197,000	512,000	297,000	474,000	355,000	321,000	591,000	87,000	443,000
September,	380,000	676,000	250,000	127,000	320,000	241,000	375,000	494,000	1,228,000	277,000	810,000	88,000
October,	243,000	1,509,000	245,000	282,000	647,000	950,000	689,000	347,000	367,000	530,000	1,382,000	158,000
November,	1,283,000	2,170,000	430,000	875,000	517,000	635,000	634,000	343,000	442,000	749,000	2,540,000	125,000
December,	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,848,000	954,000	440,000	1,018,000	794,000	1,961,000	387,000
Average,	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,248,000	1,285,000	1,025,000	926,000	1,043,000	1,180,000	847,000
Average, driest six months,	886,000	1,013,000	312,000	377,000	576,000	471,000	626,000	413,000	541,000	613,000	725,000	238,000

[1] See note at end of this table.

TABLE No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile,*[1] *1897–1920* — Concluded.

MONTH.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	Mean for 24 Years, 1897–1920.
January,	592,000	1,846,000	773,000	780,000	1,414,000	990,000	2,062,000	1,315,000	686,000	484,000	1,341,000	646,000	1,162,000
February,	2,556,000	1,845,000	625,000	927,000	867,000	1,181,000	1,961,000	1,816,000	916,000	2,024,000	794,000	725,000	1,360,000
March,	2,129,000	2,640,000	1,339,000	2,831,000	2,263,000	3,137,000	572,000	1,891,000	2,472,000	2,590,000	3,155,000	4,685,000	2,664,000
April,	2,422,000	1,034,000	1,393,000	2,281,000	2,083,000	2,593,000	926,000	3,300,000	1,468,000	1,608,000	1,711,000	3,498,000	2,155,000
May,	1,212,000	608,000	461,000	1,797,000	1,038,000	1,699,000	455,000	1,697,000	1,317,000	673,000	2,204,000	2,071,000	1,259,000
June,	632,000	824,000	351,000	331,000	280,000	317,000	228,000	2,054,000	1,229,000	523,000	462,000	1,922,000	812,000
July,	233,000	62,000	57,000	135,000	19,000	329,000	1,083,000	1,086,000	264,000	280,000	400,000	809,000	443,000
August,	193,000	186,000	188,000	125,000	60,000	261,000	1,657,000	284,000	309,000	159,000	262,000	327,000	406,000
September,	208,000	145,000	181,000	89,000	219,000	—12,000	158,000	294,000	84,000	603,000	1,093,000	540,000	369,000
October,	90,000	68,000	718,000	145,000	678,000	136,000	387,000	140,000	555,000	341,000	495,000	409,000	480,000
November,	363,000	354,000	1,035,000	442,000	660,000	211,000	498,000	321,000	313,000	582,000	1,835,000	1,301,000	777,000
December,	537,000	391,000	1,067,000	793,000	955,000	372,000	1,359,000	460,000	389,000	1,056,000	1,292,000	2,590,000	1,173,000
Average,	918,000	828,000	682,000	891,000	879,000	934,000	942,000	1,215,000	834,000	902,000	1,257,000	1,629,000	1,087,000
Average, driest six months,	270,000	201,000	327,000	210,000	318,000	208,000	666,000	432,000	320,000	412,000	752,000	878,000	546,000

[1] The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent of the whole area from 1897 to 1902 inclusive, 2.4 per cent in 1903, 3.6 per cent in 1904, 4.1 per cent in 1905, 5.1 per cent in 1906, 6.0 per cent in 1907, 7.0 per cent in 1908, 1909 and 1910, 6.5 per cent in 1911, 6.8 per cent in 1912, 6.9 per cent in 1913, 7.4 per cent in 1914 and 1915, 7.6 per cent in 1916, 7.4 per cent in 1917, 7.2 per cent in 1918, and 7.5 per cent in 1919 and 1920.

TABLE NO. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1920.*

MONTH.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
January,	103,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,235,000
February,	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000
March,	1,604,000	4,435,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000
April,	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,169,000	1,546,000	867,000	1,350,000	2,853,000	1,815,000
May,	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	937,000	1,030,000	1,336,000
June,	870,000	222,000	597,000	506,000	413,000	175,000	1,338,000	529,000	300,000	416,000	426,000
July,	321,000	183,000	202,000	128,000	157,000	176,000	276,000	86,000	115,000	224,000	62,000
August,	396,000	405,000	121,000	476,000	395,000	119,000	148,000	55,000	79,000	257,000	240,000
September,	207,000	184,000	60,000	161,000	141,000	80,000	197,000	307,000	91,000	44,000	121,000
October,	646,000	234,000	631,000	516,000	71,000	102,000	186,000	299,000	186,000	83,000	336,000
November,	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000
December,	584,000	453,000	1,290,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000
Average,	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	533,000	1,129,000	901,000
Average, driest six months,	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000	145,000	200,000	391,000

[1] See note at end of this table.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1920* — Continued.

MONTH.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
January,	1,461,000	2,589,000	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000	434,000	693,000	1,034,000	1,084,000
February,	4,801,000	2,829,000	1,950,000	1,196,000	1,529,000	3,486,000	943,000	1,542,000	991,000	541,000	2,676,000
March,	2,059,000	2,868,000	3,238,000	1,338,000	3,643,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000
April,	1,947,000	2,620,000	2,645,000	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000
May,	720,000	1,009,000	1,632,000	880,000	1,366,000	583,000	1,259,000	2,883,000	840,000	636,000	360,000
June,	203,000	413,000	421,000	653,000	568,000	413,000	428,000	440,000	419,000	174,000	399,000
July,	116,000	115,000	117,000	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000
August,	94,000	214,000	379,000	1,432,000	132,000	163,000	280,000	181,000	209,000	229,000	57,000
September,	117,000	111,000	1,155,000	823,000	457,000	203,000	229,000	108,000	150,000	89,000	388,000
October,	146,000	190,000	1,999,000	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,379,000	592,000
November,	673,000	369,000	2,758,000	1,941,000	1,215,000	305,000	697,000	319,000	836,000	2,777,000	659,000
December,	1,020,000	643,000	3,043,000	2,241,000	996,000	544,000	485,000	796,000	716,000	1,782,000	657,000
Average,	1,087,000	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,152,000	1,019,000
Average, driest six months,	223,000	234,000	953,000	944,000	747,000	239,000	327,000	237,000	356,000	460,000	314,000

[1] See note at end of this table.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1920* — Continued.

MONTH.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
January,	845,000	1,638,000	2,288,000	794,000	437,000	1,763,000	1,736,000	477,000	1,410,000	1,128,000	1,351,000	1,925,000
February,	1,067,000	3,022,000	1,381,000	3,800,000	300,000	1,674,000	2,279,000	882,000	330,000	1,041,000	624,000	1,536,000
March,	2,565,000	2,604,000	4,205,000	3,654,000	2,755,000	4,199,000	3,454,000	2,999,000	2,497,000	2,409,000	1,658,000	2,257,000
April,	1,515,000	1,829,000	2,521,000	1,350,000	4,204,000	1,885,000	2,261,000	3,294,000	1,643,000	1,949,000	1,607,000	1,117,000
May,	915,000	1,246,000	511,000	1,3.2,000	2,954,000	743,000	351,000	1,745,000	297,000	1,059,000	888,000	1,046,000
June,	962,000	530,000	66,000	316,000	753,000	303,000	1,987,000	419,000	467,000	707,000	761,000	194,000
July,	658,000	231,000	19,000	—18,000	306,000	66,000	445,000	62,000	177,000	398,000	9,000	—14,000
August,	591,000	1,107,000	—35,000	—34,000	424,000	135,000	307,000	170,000	114,000	180,000	—104,000	102,000
September,	182,000	369,000	94,000	65,000	305,000	178,000	130,000	397,000	1,246,000	19,000	541,000	—82,000
October,	94,000	1,160,000	115,000	186,000	412,000	506,000	492,000	191,000	158,000	301,000	741,000	47,000
November,	909,000	1,986,000	304,000	663,000	474,000	444,000	363,000	289,000	279,000	483,000	1,998,000	71,000
December,	1,584,000	1,799,000	220,000	1,096,000	2,695,000	1,779,000	582,000	269,000	887,000	659,000	2,032,000	136,000
Average,	991,000	1,450,000	973,000	1,082,000	1,342,000	1,140,000	1,190,000	931,000	795,000	860,000	1,010,000	694,000
Average, driest six months,	564,000	777,000	93,000	194,000	445,000	271,000	388,000	228,000	403,000	341,000	471,000	44,000

[1] See note at end of this table.

TABLE NO. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile,*[1] *1875–1920* — Concluded.

MONTH.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	Mean for 46 Years, 1875-1920.
January,	392,000	1,490,000	519,000	728,000	1,041,000	908,000	1,629,000	942,000	510,000	273,000	1,306,000	312,000	1,138,000
February,	2,286,000	1,849,000	700,000	1,197,000	754,000	1,009,000	1,870,000	1,356,000	755,000	1,809,000	917,000	743,000	1,622,000
March,	1,734,000	1,954,000	1,144,000	3,092,000	2,090,000	3,029,000	593,000	1,820,000	2,209,000	2,187,000	2,759,000	5,192,000	2,744,000
April,	1,721,000	667,000	1,426,000	2,235,000	2,232,000	2,353,000	590,000	3,037,000	1,405,000	1,466,000	1,713,000	2,911,000	1,990,000
May,	1,004,000	277,000	318,000	1,447,000	867,000	1,550,000	255,000	1,439,000	1,476,000	639,000	1,290,000	1,846,000	1,086,000
June,	239,000	516,000	213,000	148,000	149,000	5,000	101,000	1,198,000	1,044,000	185,000	112,000	1,696,000	509,000
July,	—121,000	—102,000	—14,000	—77,000	—62,000	107,000	1,045,000	585,000	43,000	96,000	299,000	284,000	184,000
August,	—45,000	—73,000	20,000	—29,000	—54,000	156,000	1,168,000	78,000	202,000	—54,000	92,000	—39,000	227,000
September,	149,000	5,000	76,000	—28,000	88,000	—135,000	38,000	26,000	58,000	637,000	713,000	64,000	230,000
October,	—51,000	—51,000	296,000	—14,000	484,000	—59,000	231,000	—5,000	482,000	274,000	279,000	—26,000	397,000
November,	82,000	176,000	593,000	165,000	480,000	97,000	261,000	110,000	438,000	489,000	1,275,000	669,000	733,000
December,	263,000	221,000	908,000	494,000	732,000	250,000	898,000	315,000	380,000	938,000	1,095,000	1,200,000	954,000
Average,	625,000	570,000	514,000	779,000	733,000	772,000	719,000	904,000	750,000	736,000	988,000	1,239,000	981,000
Average, driest six months,	40,000	29,000	151,000	26,000	180,000	29,000	480,000	186,000	267,000	269,000	458,000	360,000	378,000

[1] The area of the Sudbury watershed used in these records included water surfaces amounting to 1.9 per cent of the whole area from 1875 to 1878, inclusive, and was subsequently increased by the construction of storage reservoirs, to 3.0 per cent in 1879, 3.4 per cent in 1885, 3.9 per cent in 1894, and 6.5 per cent in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

NOTE. — Since 1897 the reservoirs on the Sudbury watershed have been full of water nearly all the time, while large quantities of water have been received from the Wachusett Reservoir and the recorded yield has been affected by these conditions, especially during dry weather.

TABLE No. 9. — *Wachusett System. — Statistics of Flow of Water, Storage and Rainfall in 1920.*

[Watershed above dam=108.84 square miles.]

MONTH.	GALLONS PER DAY.							Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Received from City of Worcester Watershed.	Discharged into Wachusett Aqueduct.[1]	Wasted into River below Dam.	Seepage through the North Dike.[2]	STORAGE.[3] Gain.	STORAGE.[3] Loss.	Total Yield of Watershed.			
January,	367,000	173,145,000	45,042,000	929,000	–	148,426,000	70,323,000	3.17	1.153	36.4
February,	–	101,738,000	1,738,000	900,000	–	25,479,000	78,897,000	6.26	1.210	19.3
March,	27,884,000	68,210,000	163,494,000	935,000	305,103,000	–	509,858,000	4.26	8.356	196.0
April,	19,978,000	172,930,000	196,547,000	1,001,000	30,262,000	–	380,762,000	6.13	6.031	98.4
May,	14,529,000	57,129,000	184,987,000	1,000,000	–	3,155,000	225,432,000	4.01	3.695	92.1
June,	3,627,000	83,747,000	135,427,000	1,000,000	–	7,377,000	209,170,000	6.07	3.317	54.6
July,	–	128,245,000	2,752,000	1,000,000	–	43,958,000	88,039,000	4.33	1.443	33.3
August,	–	131,210,000	1,713,000	977,000	–	98,287,000	35,613,000	2.91	0.584	20.1
September,	–	124,460,000	2,043,000	947,000	–	68,717,000	58,733,000	6.39	0.931	14.6
October,	–	101,051,000	8,186,000	921,000	–	65,595,000	44,563,000	0.63	0.731	116.1
November,	420,000	86,620,000	5,523,000	900,000	48,990,000	–	141,613,000	5.49	2.246	40.9
December,	4,242,000	131,226,000	3,684,000	948,000	150,274,000	–	281,890,000	6.01	4.619	76.9
Total,	–	–	–	–	–	–	–	55.66	34.316	–
Average for year,	5,950,000	113,325,000	62,661,000	955,000	6,357,000	–	177,348,000	–	–	61.7

[1] Including 199,000 gallons per day drawn from aqueduct for the supply of the Westborough State Hospital.

[2] Estimated.

[3] Aggregate storage in Wachusett Reservoir and in ponds and mill reservoirs.

TABLE No. 10. — *Sudbury System. — Statistics of Flow of Water, Storage and Rainfall in 1920.*

[Watershed=75.2 square miles.]

MONTH.	GALLONS PER DAY.									RAINFALL (INCHES).		
	Water received from Wachusett Reservoir.[1]	Water discharged through Sudbury Aqueduct.	Water discharged through Weston Aqueduct.	Water used by Framingham Water Works.	Water diverted from Watershed by Sewers, etc.	Water wasted into River below Lowest Dam.	STORAGE. Gain.	STORAGE. Loss.	Total Yield of Watershed.	Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
January,	172,935,000	91,071,000	47,687,000	1,232,000	881,000	73,432,000	–	17,916,000	23,452,000	3.26	0.556	17.1
February,	101,538,000	93,007,000	44,038,000	1,241,000	948,000	84,438,000	–	66,289,000	55,845,000	6.49	1.239	19.1
March,	68,019,000	84,865,000	44,748,000	1,171,000	2,219,000	302,316,000	23,139,000	–	390,439,000	4.45	9.262	207.9
April,	172,726,000	70,033,000	45,937,000	1,068,000	2,373,000	189,510,000	82,682,000	–	218,877,000	5.19	5.017	96.6
May,	56,916,000	66,484,000	42,171,000	1,003,000	1,984,000	108,548,000	–	24,484,000	138,790,000	3.45	3.292	95.6
June,	83,543,000	74,797,000	42,740,000	1,063,000	1,926,000	71,553,000	19,037,000	–	127,573,000	6.67	2.929	43.9
July,	128,042,000	80,574,000	38,539,000	1,158,000	1,132,000	20,742,000	7,236,000	–	21,339,000	2.04	0.506	24.9
August,	131,013,000	81,787,000	39,306,000	1,068,000	719,000	5,919,000	–	752,000	—2,965,000	1.78	—0.070	—4.0
September,	124,280,000	72,910,000	43,683,000	1,140,000	720,000	6,613,000	4,007,000	–	4,793,000	3.53	0.110	3.1
October,	100,854,000	64,336,000	43,599,000	1,095,000	792,000	4,604,000	–	15,527,000	—1,955,000	1.01	—0.046	—4.6
November,	86,427,000	57,353,000	48,556,000[2]	1,063,000	794,000	33,137,000	–	4,183,000	50,293,000	5.68	1.154	20.3
December,	131,023,000	61,552,000	46,761,000	1,039,000	1,719,000	123,752,000	–	13,542,000	90,258,000	5.11	2.141	41.9
Total,	–	–	–	–	–	–	–	–	–	48.66	26.090	–
Av. for year,	113,125,000	74,865,000	43,966,000	1,111,000	1,352,000	85,476,000	–	485,000	93,160,000	–	–	53.6

[1] Not including 199,000 gallons per day drawn from the Wachusett Aqueduct for the supply of the Westborough State Hospital, which were not discharged into Sudbury Reservoir.

[2] Includes 53,000 gallons per day wasted.

TABLE No. 11. — *Cochituate System. — Statistics of Flow of Water, Storage and Rainfall in 1920.*

[Watershed of lake=17.58 square miles.[1]]

MONTH.	GALLONS PER DAY.						Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
	Water discharged through Cochituate Aqueduct.	Water diverted from Watershed by Sewers, etc.	Water wasted at Outlet of Lake.	STORAGE. Gain.	STORAGE. Loss.	Total Yield of Watershed.			
January,	–	1,052,000	10,648,000	–	4,035,000	7,665,000	3.25	0.78	23.9
February,	–	1,007,000	49,259,000	–	27,297,000	22,969,000	7.01	2.18	31.1
March,	–	4,264,000	75,368,000	16,758,000	–	96,390,000	4.28	9.78	228.6
April,	–	7,317,000	31,154,000	11,836,000	–	50,307,000	5.61	4.93	87.9
May,	–	3,874,000	26,052,000	77,000	–	30,003,000	2.96	3.05	102.8
June,	–	2,266,000	29,780,000	867,000	–	32,913,000	7.73	3.23	41.8
July,	–	1,245,000	7,594,000	–	1,145,000	7,694,000	1.81	0.77	33.9
August,	–	793,000	–	1,910,000	–	2,703,000	1.58	0.28	17.4
September,	–	583,000	454,000	2,293,000	–	3,330,000	3.88	0.33	8.4
October,	5,583,000	509,000	2,148,000	–	6,552,000	1,688,000	1.21	0.17	2.5
November,	3,820,000	673,000	4,914,000	4,723,000	–	14,130,000	5.96	1.39	23.3
December,	–	1,506,000	36,410,000	–	11,713,000	26,203,000	5.47	2.66	48.6
Total,	–	–	–	–	–	–	50.75	29.55	–
Average for year,	787,000	2,089,000	22,735,000	–	947,000	24,664,000	–	–	58.2

[1] Not including the watersheds of Dudley and Dug ponds.

TABLE NO. 12. — *Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of Each Month.*

DATE.	Chestnut Hill Reservoir. Ordinary High Water =134.00.	Lake Cochituate. High Water =144.36.	Farm Pond. High Water =159.25.	Spot Pond. High Water =163.00.	Weston Reservoir. High Water =200.00.	FRAMINGHAM RESERVOIR. No. 1. Flash Boards 169.32.	No. 2. Flash Boards 177.12.	No. 3. Flash Boards 186.50.	Ashland. Reservoir. Flash Boards 225.23.	Sudbury Reservoir. Flash Boards 259.97.	Hopkinton Reservoir. Flash Boards 305.00.	Whitehall Reservoir. Ordinary High Water =337.91.	Wachusett Reservoir. Ordinary High Water =395.00.
Jan. 1, 1920, .	133.70	143.96	158.40	162.32	200.26	167.85	176.08	186.84	224.42	258.01	304.06	336.65	392.03
Feb. 1, 1920, .	133.78	143.43	158.44	160.94	199.68	168.04	176.20	185.62	223.27	257.51	302.08	336.17	388.49
Mar. 1, 1920, .	134.13	139.82	158.71	160.75	197.78	167.87	176.07	181.96	216.48	255.19	296.27	335.90	387.95
Apr. 1, 1920, .	133.32	142.26	159.59	161.64	199.71	168.66	176.58	183.93	219.01	255.13	298.49	337.11	394.87
May 1, 1920, .	133.43	143.78	159.67	162.02	199.88	168.31	176.36	186.77	224.71	259.08	302.76	337.91	395.65
June 1, 1920, .	133.96	143.79	159.45	162.14	196.45	167.91	176.21	183.07	224.52	258.33	304.07	336.95	395.70
July 1, 1920, .	133.65	143.90	159.59	163.06	199.52	169.57	177.36	184.39	225.26	258.87	305.01	337.00	395.54
Aug. 1, 1920, .	133.45	143.75	159.10	162.86	199.99	169.39	177.17	185.70	225.30	259.32	304.89	336.90	394.64
Sept. 1, 1920, .	133.55	144.00	158.70	163.15	199.48	169.37	177.21	185.02	225.24	259.56	304.63	336.75	392.43
Oct. 1, 1920, .	133.85	144.29	158.57	163.10	199.97	169.48	177.18	185.27	225.37	259.71	304.67	336.91	390.70
Nov. 1, 1920, .	133.85	143.43	158.31	163.08	197.92	169.34	177.16	185.44	225.25	258.65	304.56	336.81	389.22
Dec. 1, 1920, .	133.50	144.03	158.66	162.95	198.32	167.87	176.13	185.73	224.46	258.55	304.26	337.06	390.18
Jan. 1, 1921, .	133.61	142.48	159.03	162.97	199.87	167.83	176.09	186.04	224.44	257.73	304.13	336.43	393.75

TABLE No. 13. — *Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District.*

From Wachusett Reservoir into the Wachusett Aqueduct.

MONTH.	Number of Days during which Water was flowing.	ACTUAL TIME.		Million Gallons drawn.
		Hours.	Minutes.	
January,	26	372	48	5,367.5
February,	23	254	34	2,950.4
March,	21	231	25	2,114.5
April,	25	516	31	5,180.7
May,	26	416	56	1,771.0
June,	24	351	40	2,512.4
July,	29	504	20	3,975.6
August,	27	420	55	4,067.5
September,	25	364	50	3,733.8
October,	25	418	–	3,136.8
November,	25	336	40	2,598.6
December,	26	369	48	4,068.0
Totals,	302	189.94 days.		41,476.8

From Sudbury Reservoir through the Weston Aqueduct to Weston Reservoir.

MONTH.	Number of Days during which Water was flowing.	ACTUAL TIME.		Million Gallons drawn.
		Hours.	Minutes.	
January,	26	579	15	1,478.3
February,	23	462	35	1,277.1
March,	27	641	3	1,387.2
April,	25	510	46	1,376.2
May,	25	339	6	1,307.3
June,	26	327	53	1,282.2
July,	25	304	4	1,194.7
August,	26	309	56	1,218.5
September,	25	338	3	1,310.5
October,	25	345	8	1,353.4
November,	25	360	54	1,455.1
December,	26	543	47	1,449.6
Totals,	304	210.94 days.		16,090.1

TABLE No. 13 — *Concluded.*

From Framingham Reservoir No. 3 through the Sudbury Aqueduct to Chestnut Hill Reservoir.

MONTH.	Number of Days during which Water was flowing.	Actual Time (Hours).	Million Gallons drawn.
January,	31	744	2,823.2
February,	29	696	2,697.2
March,	31	744	2,630.8
April,	30	719	2,098.1
May,	31	744	2,061.0
June,	30	720	2,243.9
July,	31	744	2,497.8
August,	31	744	2,535.4
September,	30	720	2,187.3
October,	31	712	1,997.1
November,	30	720	1,720.6
December,	31	744	1,908.1
Totals,	366	364.63 days.	27,400.5

Water was drawn from Lake Cochituate to Chestnut Hill Reservoir on 29 days. The total quantity drawn was 287,900,000 gallons.

TABLE No. 14. — *Average Daily Quantity of Water flowing through Aqueducts in 1920, by Months.*[1]

MONTH.	Wachusett Aqueduct into Sudbury Reservoir (Gallons).	Weston Aqueduct into Metropolitan District (Gallons.)	Sudbury Aqueduct into Chestnut Hill Reservoir (Gallons).	Cochituate Aqueduct into Chestnut Hill Reservoir (Gallons).
January,	172,935,000	47,687,000	91,071,000	–
February,	101,538,000	44,038,000	93,007,000	–
March,	68,019,000	44,748,000	84,865,000	–
April,	172,726,000	45,937,000	70,033,000	–
May,	56,916,000	42,171,000	66,484,000	–
June,	83,543,000	42,740,000	74,797,000	–
July,	128,042,000	38,539,000	80,574,000	–
August,	131,013,000	39,306,000	81,787,000	–
September,	124,280,000	43,683,000	72,910,000	–
October,	100,854,000	43,599,000	64,336,000	5,583,000
November,	86,427,000	48,503,000	57,353,000	3,820,000
December,	131,023,000	46,761,000	61,552,000	–
Average,	113,125,000	43,962,000	74,865,000	787,000

[1] Not including quantities wasted while cleaning and repairing aqueducts.

TABLE No. 15. — (*Meter Basis.*) *Average Daily Consumption of Water by Districts in the Cities and Towns supplied by the Metropolitan Water Works in 1920.* (*For Consumption of Water in Whole Metropolitan Water District, see Table No. 17.*)

MONTH.	SOUTHERN LOW SERVICE. Boston, excluding East Boston and Charlestown (Gallons).	NORTHERN LOW SERVICE. Portions of Charlestown, Somerville, Chelsea, Everett, Malden, Medford, East Boston and Arlington (Gallons).	SOUTHERN HIGH SERVICE. Quincy, Watertown, and Portions of Boston, Belmont and Milton (Gallons).	NORTHERN HIGH SERVICE. Revere, Winthrop, Swampscott, Nahant, Stoneham, Melrose, and Portions of Boston, Chelsea, Everett, Malden, Medford and Somerville (Gallons).	SOUTHERN EXTRA HIGH SERVICE. Portions of Boston and Milton (Gallons).	NORTHERN EXTRA HIGH SERVICE. Lexington and Portions of Arlington and Belmont (Gallons).	Total District supplied (Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
January,	54,429,500	31,507,600	50,312,300	9,984,900	669,100	828,600	147,732,000	1,206,850	122
February,	55,468,600	30,605,600	48,617,100	10,079,800	688,600	856,700	146,316,400	1,207,950	121
March,	50,176,300	28,140,300	45,448,500	9,838,100	757,400	884,500	135,245,100	1,209,040	112
April,	43,058,400	25,133,800	42,480,700	8,851,600	701,700	815,700	121,041,900	1,210,140	100
May,	39,500,400	24,837,300	42,005,900	9,019,200	743,600	876,400	116,982,800	1,211,240	97
June,	44,135,600	25,232,000	43,325,700	9,560,400	805,000	873,000	123,931,700	1,212,330	102
July,	44,415,700	25,955,200	43,482,100	10,902,300	754,400	1,026,200	126,535,900	1,213,430	104
August,	44,663,200	25,667,800	44,072,900	10,881,700	716,400	1,170,500	127,172,500	1,215,620	105
September,	43,542,800	25,048,400	43,420,700	9,804,400	738,000	901,500	123,455,800	1,217,820	101
October,	44,193,100	24,528,700	43,506,700	9,038,500	753,200	892,800	122,913,000	1,220,010	101
November,	42,730,700	23,716,500	42,175,900	8,699,400	748,000	837,700	118,908,200	1,222,200	97
December,	40,896,600	23,925,900	42,558,100	8,541,300	764,200	792,700	117,478,800	1,224,400	96
For the year,	45,571,400	26,182,900	44,275,900	9,601,500	736,800	897,000	127,265,500	1,213,430	105

In addition to the above quantities the United States Government Reservation on Peddock's Island was supplied with 15,757,000 gallons, equivalent to an average daily rate of 43,100 gallons, and a part of Saugus with 10,723,000 gallons, equivalent to an average daily rate of 29,300 gallons.

TABLE NO. 16. — (*Meter Basis.*) *Average Daily Consumption of Water in Cities and Towns supplied by the Metropolitan Water Works in 1920.*

City or town, . . .	ARLINGTON.		BELMONT.		BOSTON.		CHELSEA.		EVERETT.		LEXINGTON.		MALDEN.	
Population, . . .	18,780.		10,880.		751,810.		43,380.		40,350.		6,390.		49,350.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January, ...	1,049,100	56	568,700	53	111,225,900	149	4,092,700	95	3,830,600	95	397,700	63	2,864,400	58
February, . . .	1,053,100	56	586,600	54	110,245,700	147	3,912,700	91	3,702,000	92	392,000	62	2,860,600	58
March, ...	992,400	53	612,100	57	100,853,400	135	3,698,900	86	3,585,700	89	442,100	70	2,798,600	57
April, ...	935,300	50	642,800	59	89,630,000	120	3,357,800	78	3,278,100	81	393,000	62	2,720,100	55
May, ...	1,020,000	54	553,600	51	85,563,000	114	3,191,300	74	3,212,700	80	405,300	64	2,716,400	55
June, ...	1,013,600	54	558,600	51	91,670,500	122	3,139,500	72	3,215,500	80	424,800	67	2,766,500	56
July, ...	1,241,100	66	623,500	57	92,021,700	122	3,236,900	75	3,329,500	83	474,300	74	2,875,000	58
August, ...	1,453,700	77	769,500	70	91,830,300	122	3,199,400	74	3,439,800	85	536,700	84	3,156,300	64
September, . . .	1,070,500	57	592,300	54	90,666,000	120	3,254,400	75	3,386,600	84	436,400	68	2,977,600	60
October, ...	992,100	53	553,700	50	91,714,900	121	2,989,500	69	3,447,000	85	424,000	66	2,719,200	55
November, . . .	933,200	49	520,400	47	88,853,200	117	2,853,000	65	3,518,000	87	395,400	61	2,621,500	53
December, . . .	904,200	48	512,500	46	87,795,400	116	2,888,400	66	3,518,900	86	365,800	57	2,445,100	49
For the year, . .	1,055,600	56	591,400	54	94,297,400	125	3,316,400	76	3,455,200	86	424,300	66	2,793,300	57

TABLE No. 16. — *Average Daily Consumption of Water in Cities and Towns, etc.* — Continued.

City or town,	MEDFORD.		MELROSE.		MILTON.		NAHANT.		QUINCY.		REVERE.	
Population,	39,460.		18,270.		9,420.		1,330.		48,200.		29,120.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,	1,882,000	48	1,164,900	64	408,900	44	163,800	124	4,983,800	104	2,098,800	73
February,	1,853,400	47	1,168,000	64	429,200	46	157,700	119	4,913,000	103	2,078,400	72
March,	1,782,600	45	1,225,700	67	448,800	48	125,800	95	4,424,200	92	1,910,300	66
April,	1,655,600	42	1,037,700	57	412,900	44	98,000	74	4,159,000	87	1,732,500	60
May,	1,756,500	45	1,043,600	57	424,100	45	161,700	122	4,210,600	88	1,830,000	63
June,	1,790,300	45	1,049,600	57	457,300	49	225,100	169	4,399,800	91	2,010,900	69
July,	1,892,200	48	1,143,000	63	442,500	47	374,100	281	4,586,800	95	2,333,300	80
August,	1,738,700	44	1,231,100	67	402,000	43	361,600	272	4,737,800	98	2,284,700	78
September,	1,654,600	42	1,124,300	61	424,200	45	274,800	205	4,543,400	94	2,003,500	68
October,	1,684,600	42	1,088,400	59	460,000	49	170,000	127	4,380,600	90	1,841,000	63
November,	1,583,000	40	1,016,600	55	452,800	48	104,000	78	4,186,800	86	1,825,700	62
December,	1,601,800	40	1,001,600	54	408,800	43	89,500	66	4,153,700	85	1,757,700	59
For the year,	1,739,700	44	1,108,100	61	430,900	46	192,600	145	4,472,500	93	1,975,900	68

TABLE No. 16. — *Average Daily Consumption of Water in Cities and Towns, etc.* — Concluded.

City or town,	SOMERVILLE.		STONEHAM.		SWAMPSCOTT.		WATERTOWN.		WINTHROP.		METROPOLITAN DISTRICT.	
Population,	93,530.		7,890.		8,150.		21,530.		15,590.		1,213,430.	
	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
MONTH.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,	8,574,600	92	1,016,400	129	506,700	63	2,036,600	95	866,400	56	147,732,000	122
February,	8,320,200	89	1,029,300	131	529,100	65	2,219,300	103	866,100	56	146,316,400	121
March,	7,869,700	84	1,002,200	127	541,000	67	2,071,400	96	860,200	55	135,245,100	112
April,	6,862,200	74	782,600	99	536,500	66	2,023,600	94	784,200	51	121,041,900	100
May,	6,782,700	73	715,000	91	595,700	73	2,000,000	93	800,600	51	116,982,800	97
June,	6,858,900	73	726,600	92	727,400	89	2,051,700	95	845,100	54	123,931,700	102
July,	7,052,700	75	776,900	98	913,000	112	2,123,000	99	1,096,400	70	126,535,900	104
August,	7,031,600	75	802,500	102	920,600	113	2,172,500	101	1,103,700	71	127,172,500	105
September,	6,763,100	72	661,000	84	788,800	96	1,904,100	88	930,200	59	123,455,800	101
October,	6,761,800	72	672,200	85	654,200	80	1,542,600	71	817,200	52	122,913,000	101
November,	6,636,600	71	634,700	80	591,200	72	1,403,000	65	779,100	49	118,908,200	97
December,	6,636,300	70	660,100	83	574,000	70	1,403,600	65	761,400	48	117,478,800	96
For the year,	7,177,300	77	789,600	100	657,200	81	1,911,700	89	876,400	56	127,265,500	105

TABLE No. 17. — *Consumption of Water in the Metropolitan Water District, as constituted in the Year 1920, and a Small Section of the Town of Saugus, 1893–1920.*

[Gallons per Day.]

MONTH.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January,	75,209,000	67,506,000	68,925,000	82,946,000	85,366,000	83,880,000	96,442,000	100,055,000	111,275,000
February,	71,900,000	68,944,000	80,375,000	87,021,000	83,967,000	87,475,000	103,454,000	98,945,000	117,497,000
March,	67,638,000	62,710,000	69,543,000	86,111,000	82,751,000	85,468,000	90,200,000	97,753,000	105,509,000
April,	62,309,000	57,715,000	62,909,000	77,529,000	79,914,000	76,574,000	86,491,000	89,497,000	93,317,000
May,	61,025,000	60,676,000	65,194,000	73,402,000	76,772,000	76,677,000	89,448,000	87,780,000	95,567,000
June,	63,374,000	68,329,000	69,905,000	77,639,000	77,952,000	83,463,000	97,691,000	98,581,000	103,420,000
July,	69,343,000	73,642,000	69,667,000	80,000,000	85,525,000	88,228,000	96,821,000	107,786,000	106,905,000
August,	66,983,000	67,995,000	72,233,000	78,537,000	84,103,000	87,558,000	92,072,000	102,717,000	102,815,000
September,	64,654,000	67,137,000	73,724,000	74,160,000	84,296,000	88,296,000	91,478,000	103,612,000	102,103,000
October,	63,770,000	62,735,000	67,028,000	71,762,000	79,551,000	81,770,000	89,580,000	98,358,000	103,389,000
November,	61,204,000	62,231,000	64,881,000	71,933,000	72,762,000	78,177,000	86,719,000	93,648,000	101,324,000
December,	66,700,000	65,108,000	70,443,000	79,449,000	76,594,000	86,355,000	85,840,000	97,844,000	113,268,000
Average,	66,165,000	65,382,000	69,499,000	78,360,000	80,793,000	83,651,000	92,111,000	98,059,000	104,645,000
Population,	724,180	744,720	765,430	787,880	810,340	832,790	855,250	877,700	892,740
Per capita,	91.4	87.8	90.8	99.5	99.7	100.4	107.7	111.7	117.2

See note at end of this table.

TABLE No. 17. — *Consumption of Water, etc.* — Continued.

[Gallons per Day.]

MONTH.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
January,	118,435,000	125,176,000	137,771,000	130,878,000	126,093,000	137,730,000	132,376,000	133,275,000	127,568,000
February,	117,268,000	122,728,000	143,222,000	140,595,000	130,766,000	150,822,000	146,199,000	130,763,000	131,093,000
March,	108,461,000	111,977,000	123,334,000	120,879,000	123,570,000	134,202,000	128,884,000	126,842,000	117,078,000
April,	103,153,000	107,179,000	108,688,000	111,898,000	118,428,000	121,556,000	128,926,000	125,335,000	112,775,000
May,	106,692,000	111,589,000	111,715,000	115,804,000	122,404,000	123,502,000	131,040,000	123,305,000	112,073,000
June,	110,002,000	105,590,000	111,209,000	117,441,000	121,882,000	125,623,000	139,843,000	125,179,000	114,082,000
July,	108,340,000	107,562,000	113,584,000	124,769,000	118,726,000	128,779,000	138,232,000	126,765,000	122,743,000
August,	107,045,000	103,570,000	112,836,000	121,158,000	120,591,000	131,098,000	128,073,000	121,781,000	118,373,000
September,	107,752,000	106,772,000	114,188,000	120,103,000	121,685,000	124,751,000	129,972,000	118,043,000	112,434,000
October,	106,560,000	103,602,000	108,290,000	118,301,000	116,561,000	124,051,000	124,189,000	115,939,000	112,332,000
November,	105,175,000	103,477,000	108,054,000	116,693,000	113,746,000	119,627,000	117,119,000	111,664,000	107,528,000
December,	125,434,000	114,721,000	125,119,000	122,696,000	130,995,000	122,407,000	124,468,000	115,733,000	121,994,000
Average,	110,345,000	110,277,000	118,114,000	121,671,000	122,085,000	128,561,000	130,712,000	122,851,000	117,458,000
Population,	907,780	922,820	937,860	955,920	981,720	1,007,520	1,025,890	1,051,420	1,077,090
Per capita,	121.6	119.5	125.9	127.3	124.4	127.6	127.4	116.8	109.1

See note at end of this table.

TABLE No. 17. — *Consumption of Water, etc.* — Concluded.

[Gallons per Day.]

MONTH.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.
January,	123,281,000	137,277,000	113,489,000	117,387,000	109,689,000	110,202,000	115,416,000	146,582,000	130,592,000	148,905,000
February,	124,359,000	141,440,000	120,713,000	127,083,000	108,361,000	112,338,000	120,840,000	156,628,000	124,701,000	146,332,000
March,	116,669,000	122,804,000	107,871,000	110,106,000	102,241,000	109,944,000	109,068,000	140,078,000	116,152,000	135,168,000
April,	111,656,000	113,308,000	104,086,000	103,609,000	98,085,000	100,326,000	102,817,000	125,975,000	114,284,000	123,566,000
May,	118,095,000	114,548,000	104,311,000	105,821,000	98,940,000	103,940,000	102,883,000	126,139,000	115,403,000	119,466,000
June,	114,145,000	118,793,000	108,193,000	114,165,000	104,252,000	103,349,000	106,043,000	128,152,000	123,757,000	123,027,000
July,	123,052,000	120,261,000	112,084,000	106,233,000	101,074,000	106,392,000	113,344,000	127,289,000	124,166,000	125,766,000
August,	111,091,000	112,968,000	106,660,000	105,786,000	101,331,000	110,090,000	114,870,000	128,642,000	119,613,000	125,433,000
September,	108,726,000	112,352,000	105,449,000	109,873,000	108,043,000	108,691,000	109,467,000	125,352,000	123,748,000	122,091,000
October,	106,873,000	110,220,000	103,756,000	105,241,000	103,622,000	108,008,000	107,104,000	121,798,000	122,186,000	121,473,000
November,	105,373,000	109,289,000	101,441,000	101,228,000	101,474,000	103,835,000	103,892,000	119,242,000	119,978,000	117,496,000
December,	104,592,000	110,114,000	102,480,000	108,741,000	102,074,000	106,777,000	120,326,000	122,502,000	132,150,000	118,516,000
Average,	113,951,000	118,546,000	107,466,000	109,489,000	103,227,000	106,994,000	110,475,000	130,551,000	122,227,000	127,228,000
Population,	1,103,290	1,129,500	1,155,710	1,181,920	1,204,300	1,215,160	1,226,020	1,236,880	1,247,750	1,259,920
Per capita,	103.3	105.0	93.0	92.6	85.7	88.0	90.1	105.5	97.9	101.0

This table includes the water consumed in the cities and towns enumerated in Table No. 16, together with the water consumed in Newton, which is included in the Metropolitan Water District but has not been supplied from the Metropolitan Works, and a small section of the town of Saugus.

From 1893 to 1903, inclusive, consumption based on pumpage. Since 1903, portion of supply delivered by gravity and measured by meters.

On account of revision of populations, the population and per capita figures in this report for 1915 to 1919, inclusive, differ from those published in the corresponding table in previous annual reports.

TABLE NO. 18. — *Chemical Examinations of Water from the Wachusett Reservoir, Clinton.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
			Color.						Albuminoid.				
	Turbidity.	Sediment.	Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		
Jan. 6	V. slight.	None.	.15	V. faintly vegetable.	V. faintly vegetable.	3.60	1.10	.0032	.0098	.0084	.0014	.28	1.3
Jan. 26	V. slight.	None.	.15	V. faintly vegetable.	Faintly vegetable.	3.35	1.00	.0042	.0166	.0118	.0048	.32	1.1
Feb. 2	None.	None.	.13	V. faintly vegetable.	Faintly vegetable.	3.20	1.40	.0032	.0176	.0116	.0060	.32	1.3
Mar. 16	None.	None.	.15	V. faintly vegetable.	Faintly vegetable.	3.60	1.45	.0020	.0084	.0084	.0000	.32	1.8
Apr. 6	V. slight.	V. slight.	.16	V. faintly vegetable.	V. faintly vegetable.	3.75	1.35	.0012	.0098	.0094	.0004	.24	1.0
Apr. 22	V. slight.	V. slight.	.19	V. faintly vegetable.	V. faintly vegetable.	3.80	1.75	.0014	.0124	.0102	.0022	.26	1.1
May 11	V. slight.	V. slight.	.18	V. faintly vegetable.	V. faintly vegetable.	3.55	1.60	.0006	.0116	–	–	.25	1.1
May 18	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	3.35	1.20	.0004	.0152	.0120	.0032	.30	0.6
June 8	V. slight.	V. slight.	.20	V. faintly vegetable.	Faintly vegetable.	4.40	1.80	.0008	.0122	.0102	.0020	.22	1.0
June 22	V. slight.	V. slight.	.20	V. faintly vegetable.	V. faintly vegetable.	3.35	1.30	.0012	.0116	.0114	.0002	.24	1.1
July 6	V. slight.	V. slight.	.19	V. faintly vegetable.	Faintly vegetable.	2.75	1.25	.0012	.0134	.0122	.0012	.26	0.6
July 20	V. slight.	V. slight.	.16	V. faintly vegetable.	Faintly vegetable.	3.95	1.30	.0036	.0082	.0080	.0002	.28	1.0
Aug. 3	V. slight.	V. slight.	.12	V. faintly vegetable.	V. faintly vegetable.	3.15	1.20	.0026	.0104	.0090	.0014	.22	1.3
Aug. 17	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	4.80	1.30	.0058	.0160	.0136	.0024	.30	1.6
Sept. 7	V. slight.	V. slight.	.14	V. faintly vegetable.	Faintly vegetable.	2.95	1.15	.0020	.0118	.0108	.0010	.24	1.0
Sept. 20	V. slight.	V. slight.	.13	V. faintly vegetable.	V. faintly vegetable.	3.50	1.40	.0022	.0116	–	–	.26	0.8
Oct. 5	V. slight.	None.	.11	V. faintly vegetable.	V. faintly vegetable.	3.00	1.10	.0012	.0124	.0108	.0016	.30	1.1
Oct. 19	V. slight.	V. slight.	.12	Faintly vegetable.	Distinctly vegetable.	3.25	1.20	.0008	.0100	.0084	.0016	.20	1.1
Nov. 9	V. slight.	V. slight.	.13	V. faintly vegetable.	V. faintly vegetable.	4.00	1.10	.0008	.0122	.0104	.0018	.22	1.3
Nov. 23	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.95	1.05	.0012	.0094	.0082	.0012	.24	1.6
Dec. 7	V. slight.	None.	.12	V. faintly vegetable.	Faintly vegetable.	3.50	1.20	.0010	.0084	.0072	.0012	.24	1.0
Dec. 28	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.25	1.25	.0014	.0106	.0082	.0024	.32	1.1
Av.	.....	.....	.15	.....	.....	3.55	1.29	.0019	.0118	.0100	.0018	.27	1.1

TABLE No. 19. — *Chemical Examinations of Water from the Sudbury Reservoir.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		
Jan. 6	V. slight.	V. slight.	.20	V. faintly vegetable.	V. faintly vegetable.	5.00	2.50	.0022	.0130	.0128	.0002	.40	1.0
Feb. 4	V. slight.	V. slight.	.14	V. faintly vegetable.	Faintly vegetable.	4.55	1.05	.0022	.0122	.0114	.0008	.26	1.6
Mar. 10	V. slight.	None.	.15	V. faintly vegetable.	V. faintly vegetable.	3.25	1.20	.0038	.0122	.0104	.0018	.30	1.3
Apr. 6	V. slight.	V. slight.	.20	V. faintly vegetable.	Faintly vegetable.	–	–	.0076	.0148	.0092	.0056	.28	1.4
May 4	V. slight.	V. slight.	.21	V. faintly vegetable.	Faintly vegetable.	3.75	1.10	.0012	.0122	.0100	.0022	.26	1.8
June 8	V. slight.	V. slight.	.21	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	4.00	1.60	.0018	.0136	.0124	.0012	.30	1.1
July 6	V. slight.	V. slight.	.22	V. faintly vegetable.	Faintly vegetable.	4.50	1.95	.0018	.0174	.0150	.0024	.31	1.1
Aug. 10	V. slight.	V. slight.	.14	V. faintly vegetable.	Faintly vegetable.	5.25	1.85	.0046	.0156	.0124	.0032	.34	2.1
Sept. 7	V. slight.	V. slight.	.13	V. faintly vegetable.	Faintly vegetable.	4.00	1.50	.0022	.0118	.0106	.0012	.30	1.6
Oct. 5	V. slight.	V. slight.	.14	V. faintly vegetable.	V. faintly vegetable.	3.55	1.60	.0028	.0136	.0106	.0030	.34	1.4
Nov. 9	V. slight.	V. slight.	.13	V. faintly vegetable.	Faintly vegetable.	3.45	1.20	.0016	.0144	.0088	.0056	.32	1.0
Dec. 7	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.20	1.05	.0006	.0102	.0090	.0012	.29	1.1
Av.	.....	.....	.16	.....	.....	4.05	1.51	.0027	.0134	.0111	.0024	.31	1.4

TABLE No. 20. — *Chemical Examinations of Water from Spot Pond, Stoneham.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		
Apr. 5	V. slight.	V. slight.	.11	V. faintly vegetable.	Faintly vegetable.	3.80	1.60	.0028	.0126	.0096	.0030	.30	1.3
May 3	V. slight.	None.	.10	V. faintly vegetable.	Faintly vegetable.	3.90	1.40	.0004	.0140	.0134	.0006	.30	1.6
June 2	V. slight.	V. slight.	.09	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	4.20	1.45	.0016	.0122	.0104	.0018	.35	1.6
July 6	V. slight.	None.	.08	V. faintly vegetable.	Faintly vegetable.	3.70	1.80	.0008	.0178	.0120	.0058	.32	1.6
Aug. 9	V. slight.	V. slight.	.10	V. faintly vegetable.	V. faintly vegetable.	4.05	1.60	.0018	.0110	.0100	.0010	.30	1.3
Sept. 7	V. slight.	V. slight.	.11	V. faintly vegetable.	Faintly vegetable.	3.45	1.35	.0020	.0130	.0110	.0020	.37	1.3
Oct. 4	V. slight.	V. slight.	.08	V. faintly vegetable.	Faintly vegetable.	4.45	1.90	.0018	.0140	.0108	.0032	.37	1.4
Nov. 1	V. slight.	V. slight.	.08	V. faintly vegetable.	Faintly vegetable.	4.55	2.10	.0010	.0126	.0098	.0028	.36	1.4
Dec. 6	V. slight.	V. slight.	.06	V. faintly vegetable.	Faintly vegetable.	3.60	1.45	.0006	.0104	.0094	.0010	.30	1.6
Av.	.....	.....	.09	.....	.....	3.97	1.63	.0013	.0131	.0107	.0023	.33	1.5

TABLE No. 21. — *Chemical Examinations of Water from Lake Cochituate.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
			Color.						Albuminoid.				
	Turbidity.	Sediment.	Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		
Jan. 5	V. slight.	Slight.	.20	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	6.95	2.00	.0036	.0196	.0180	.0016	.76	2.9
Feb. 2	V. slight.	None.	.30	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	7.15	2.15	.0078	.0260	.0202	.0058	.78	3.0
Mar. 9	V. slight.	V. slight.	.35	Faintly vegetable.	Distinctly vegetable.	7.45	2.05	.0032	.0226	.0176	.0050	.70	3.1
Apr. 8	V. slight.	V. slight.	.29	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	6.20	2.00	.0070	.0140	.0128	.0012	.56	2.6
May 3	V. slight.	Slight.	.27	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	5.00	1.60	.0002	.0192	.0156	.0036	.56	2.2
June 7	V. slight.	Slight.	.25	V. faintly vegetable.	Faintly vegetable.	5.60	2.15	.0020	.0176	.0154	.0022	.60	2.2
July 7	V. slight.	Slight.	.21	V. faintly vegetable and sweetish.	Faintly vegetable and sweetish.	4.75	1.40	.0006	.0218	.0174	.0044	.64	2.7
Aug. 2	V. slight.	V. slight.	.22	V. faintly vegetable.	Faintly vegetable.	5.35	1.55	.0018	.0158	.0134	.0024	.54	2.5
Sept. 7	V. slight.	V. slight.	.15	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	5.55	1.85	.0016	.0198	.0172	.0026	.65	2.5
Oct. 7	V. slight.	Slight.	.10	Faintly vegetable and marshy.	Distinctly vegetable and marshy.	5.55	2.00	.0016	.0198	.0132	.0066	.58	2.3
Nov. 9	Slight.	Slight.	.12	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	6.60	1.60	.0002	.0278	.0182	.0096	.58	2.6
Dec. 6	V. slight.	V. slight.	.10	Faintly vegetable and unpleasant.	Distinctly vegetable and unpleasant.	6.30	2.15	.0022	.0204	.0112	.0092	.60	2.2
Av.	.....	.....	.21	.....	.....	6.04	1.88	.0026	.0204	.0159	.0045	.63	2.6

TABLE No. 22. — *Chemical Examinations of Water from a Tap at the State House, Boston.*

[Parts per 100,000.]

Date of Collection.	Appearance.			Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
	Turbidity.	Sediment.	Color. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Dissolved.	Suspended.		
Jan. 5	V. slight.	V. slight.	.20	V. faintly vegetable.	V. faintly vegetable.	4.20	1.00	.0020	.0108	.0098	.0010	.35	1.6
Feb. 9	V. slight.	V. slight.	.19	V. faintly vegetable.	Faintly vegetable.	3.75	1.00	.0020	.0100	.0096	.0004	.42	1.6
Mar. 9	V. slight.	V. slight.	.19	V. faintly vegetable.	V. faintly vegetable.	4.70	1.80	.0028	.0080	.0072	.0008	.36	1.8
Apr. 6	V. slight.	V. slight.	.16	V. faintly vegetable.	V. faintly vegetable.	3.85	1.25	.0026	.0112	.0072	.0040	.32	1.7
May 3	V. slight.	V. slight.	.23	V. faintly vegetable.	Faintly vegetable.	4.70	2.05	.0006	.0120	–	–	.30	1.8
June 8	V. slight.	V. slight.	.19	V. faintly vegetable.	Faintly vegetable.	3.95	1.05	.0006	.0130	.0096	.0034	.31	1.6
July 6	V. slight.	V. slight.	.21	V. faintly vegetable.	V. faintly vegetable.	4.60	1.65	.0004	.0126	.0116	.0010	.33	1.1
Aug. 9	None.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	4.70	1.50	.0006	.0094	.0082	.0012	.32	.08
Sept. 8	V. slight.	V. slight.	.13	V. faintly vegetable.	Faintly vegetable.	3.85	1.20	.0010	.0104	.0098	.0006	.28	1.7
Oct. 6	V. slight.	V. slight.	.14	None.	V. faintly vegetable.	3.55	1.15	.0006	.0120	.0104	.0016	.28	1.0
Nov. 8	V. slight.	V. slight.	.15	V. faintly vegetable.	Faintly vegetable.	4.25	1.35	.0006	.0152	.0144	.0008	.34	1.6
Dec. 6	V. slight.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable.	4.65	1.15	.0002	.0092	.0090	.0002	.34	1.7
Av.	.....	.....	.17	.....	.....	4.23	1.35	.0012	.0112	.0097	.0014	.33	1.5

TABLE No. 23. — *Averages of Chemical Examinations of Water from Various Parts of the Metropolitan Water Works in 1920.*

[Parts per 100,000.]

Locality.	Samples collected.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Hardness.
		Platinum Standard.	Total.	Loss on Ignition.	Free.	Albuminoid.				
						Total.	Dissolved.	Suspended.		
Quinapoxet River, Holden,	Semi-monthly,	.45	3.99	1.56	.0026	.0157	.0130	.0027	.25	0.9
Stillwater River, Sterling,	Semi-monthly,	.38	3.79	1.50	.0029	.0151	.0130	.0021	.20	1.1
Wachusett Reservoir, West Boylston,[1]	Semi-monthly,	.29	3.71	1.36	.0025	.0161	.0139	.0022	.24	1.2
Wachusett Reservoir, Clinton, surface,[1]	Semi-monthly,	.15	3.55	1.29	.0019	.0118	.0100	.0018	.27	1.1
Wachusett Reservoir, Clinton, bottom,[1]	Semi-monthly,	.15	3.36	1.22	.0017	.0104	.0089	.0014	.26	1.2
Marlborough (Walker's Brook),[2]	Monthly,	.58	20.52	6.09	.0843	.0309	.0282	.0058	2.85	6.4
Marlborough Brook filter beds, effluent,[2]	Monthly,	.09	14.98	–	.0098	.0106	–	–	2.14	5.7
Wachusett Aqueduct, Southborough,	Monthly,	.24	3.92	1.59	.0014	.0119	.0109	.0012	.27	1.4
Sudbury Reservoir, surface,	Monthly,	.16	4.05	1.51	.0027	.0134	.0111	.0024	.31	1.4
Sudbury Reservoir, bottom,	Monthly,	.17	3.94	1.50	.0039	.0122	.0104	.0018	.30	1.5
Framingham Reservoir No. 3, inlet,	Monthly,	.17	3.78	1.33	.0030	.0129	.0104	.0024	.29	1.4
Framingham Reservoir, No. 3, near dam,	Monthly,	.18	4.10	1.53	.0035	.0162	.0133	.0029	.31	1.5
Hopkinton Reservoir, inlet,[2]	Monthly,	.88	5.45	2.50	.0031	.0230	.0202	.0028	.44	1.4
Hopkinton Reservoir, surface,	Monthly,	.58	4.32	1.83	.0038	.0179	.0149	.0030	.32	1.1
Hopkinton Reservoir, bottom,	Monthly,	.56	3.96	1.62	.0033	.0148	.0128	.0020	.33	1.1
Ashland Reservoir, inlet,	Monthly,	1.06	5.70	2.55	.0046	.0258	.0226	.0041	.35	1.7
Ashland Reservoir, surface,	Monthly,	.56	4.27	1.89	.0027	.0179	.0150	.0028	.28	1.3
Ashland Reservoir, bottom,	Monthly,	.52	4.10	1.66	.0043	.0189	.0165	.0022	.29	1.3
Framingham Reservoir No. 2, inlet,	Monthly,	.74	6.95	2.37	.0060	.0230	.0201	.0029	.73	1.8
Framingham Reservoir No. 2, near dam,	Monthly,	.77	6.43	2.26	.0058	.0232	.0195	.0037	.60	1.6
Lake Cochituate, surface,	Monthly,	.21	6.04	1.88	.0026	.0204	.0159	.0045	.63	2.6
Lake Cochituate, bottom,	Monthly,	.58	7.59	2.33	.0552	.0223	.0177	.0046	.65	2.9
Weston Reservoir,[3]	Monthly,	.16	4.04	1.40	.0027	.0134	.0118	.0018	.35	1.5
Terminal chamber, Sudbury Aqueduct,[3]	Monthly,	.17	4.02	1.48	.0026	.0115	.0096	.0019	.32	1.5
Spot Pond,[4]	Monthly,	.09	3.97	1.63	.0013	.0131	.0107	.0023	.33	1.5
Tap in Revere,[4]	Monthly,	.07	3.87	1.22	.0010	.0111	.0099	.0012	.33	1.5
Tap at State House,	Monthly,	.17	4.23	1.35	.0012	.0112	.0097	.0014	.33	1.5
Tap in Quincy,[2]	Monthly,	.14	3.96	1.39	.0006	.0105	.0094	.0011	.32	1.6

[1] Averages of 22 samples. [2] Averages of 10 samples. [3] Averages of 11 samples. [4] Averages of 9 samples.

TABLE No. 24. — *Chemical Examinations of Water from a Faucet in Boston, 1892–1920.*

[Parts per 100,000.]

YEAR.	COLOR.	RESIDUE ON EVAPORATION.		AMMONIA.				CHLORINE.	OXYGEN CONSUMED.	HARDNESS.
					ALBUMINOID.					
	Platinum Standard.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.			
1892,	.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	–	1.9
1893,	.53	4.54	1.84	.0010	.0174	.0147	.0027	.38	.60	1.8
1894,	.58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.63	1.7
1895,	.59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.69	0.7
1896,	.45	4.29	1.67	.0005	.0165	.0142	.0023	.37	.56	1.4
1897,	.55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.64	1.6
1898,	.40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.44	1.4
1899,	.28	3.70	1.30	.0006	.0136	.0122	.0014	.24	.35	1.1
1900,	.29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.38	1.3
1901,	.29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.42	1.7
1902,	.30	3.93	1.56	.0016	.0139	.0119	.0020	.29	.40	1.3
1903,	.29	3.98	1.50	.0013	.0125	.0110	.0015	.30	.39	1.5
1904,	.23	3.93	1.59	.0023	.0139	.0121	.0018	.34	.37	1.5
1905,	.24	3.86	1.59	.0020	.0145	.0124	.0021	.35	.35	1.4
1906,	.24	3.86	1.39	.0018	.0159	.0134	.0025	.34	.36	1.3
1907,	.22	3.83	1.40	.0013	.0129	.0109	.0020	.33	.32	1.3
1908,	.19	3.50	1.35	.0011	.0115	.0092	.0024	.33	.26	1.2
1909,	.18	3.46	1.43	.0011	.0128	.0103	.0025	.28	.25	1.3
1910,	.14	3.05	1.24	.0013	.0118	.0102	.0016	.28	.22	1.1
1911,	.25	4.18	1.66	.0015	.0156	.0128	.0029	.38	.33	1.4
1912,	.17	3.86	1.23	.0018	.0154	.0119	.0034	.36	.29	1.7
1913,	.13	3.96	1.15	.0014	.0150	.0120	.0026	.35	.26	1.5
1914,	.14	4.12	1.19	.0014	.0138	.0116	.0022	.39	.25	1.4
1915,	.16	3.73	1.04	.0015	.0157	.0134	.0023	.38	.25	1.4
1916,	.18	4.53	1.85	.0013	.0133	.0107	.0026	.36	–	1.4
1917,	.15	4.45	1.68	.0015	.0142	.0124	.0018	.33	–	1.3
1918,	.18	3.89	1.45	.0019	.0154	.0128	.0026	.29	–	1.4
1919,	.20	4.28	1.41	.0010	.0130	.0108	.0022	.36	–	1.5
1920,	.17	4.23	1.35	.0012	.0112	.0097	.0014	.33	–	1.5

TABLE No. 25. — *Microscopic Organisms in Water from Various Parts of the Metropolitan Water Works, 1898–1920.*

[Standard units per cubic centimeter; averages from weekly or biweekly observations.]

YEAR.	WACHUSETT RESERVOIR.		SUDBURY RESERVOIR.		LAKE COCHITUATE.		FRAMINGHAM RESERVOIR No. 3.	FRAMINGHAM RESERVOIR No. 2.	ASHLAND RESERVOIR.	HOPKINTON RESERVOIR.	WHITEHALL RESERVOIR.
	Surface.	Bottom.	Surface.	Bottom.	Surface.	Bottom.	Surface.	Mid-depth.	Surface.	Surface.	Surface.
1898,	–	–	354	149	830	696	390	245	263	944	690
1899,	–	–	470	252	905	644	440	218	357	715	393
1900,	–	–	498	361	1,758	1,071	645	365	390	980	437
1901,	–	–	337	225	992	702	336	149	244	450	705
1902,	–	–	590	402	1,071	730	627	204	550	588	198
1903,	–	–	549	388	931	795	459	169	323	231	327
1904,	313	–	517	376	663	542	475	174	153	106	375
1905,	769	592	644	502	1,255	503	535	158	289	240	147
1906,	446	272	953	714	1,407	1,143	692	226	431	475	1,279
1907,	425	212	513	419	1,123	1,200	413	205	378	336	961
1908,	731	466	850	885	1,559	1,241	932	725	699	516	708
1909,	2,151	1,937	2,474	2,513	1,142	1,198	2,372	610	603	294	445
1910,	480	328	464	556	928	1,033	455	436	426	387	154
1911,	649	368	990	988	1,942	2,216	1,140	378	592	457	397
1912,	585	368	939	882	4,682	7,873	888	241	665	516	390
1913,	449	270	553	541	4,964	7,322	560	253	414	298	494
1914,	753	309	735	692	2,036	4,189	532	–	327	325	89
1915,	519	356	1,005	828	1,900	3,213	701	–	450	284	625
1916,	922	550	930	992	2,708	1,949	837	–	425	347	148
1917,	296	240	658	589	1,670	2,216	663	–	–	–	–
1918,	229	132	475	332	3,492	2,800	455	–	–	–	–
1919,	380	352	482	527	3,673	2,878	406	–	–	–	–
1920,	248	143	293	297	1,545	1,715	257	–	–	–	–

See note at end of this table.

TABLE No. 25. — *Microscopic Organisms in Water, etc.* — Concluded.

[Standard units per cubic centimeter; averages from weekly or biweekly observations.]

YEAR.	WESTON RESERVOIR.	SPOT POND.	CHESTNUT HILL RESERVOIR.			TAPS.			
			SUDBURY AQUEDUCT.	COCHITUATE AQUEDUCT.	EFFLUENT GATE-HOUSE.	Southern Low Service.	Southern High Service.	Northern Low Service.	Northern High Service.
	Surface.	Surface.	Inlet.	Inlet.	No. 2.				
1898,	–	485	304	544	304	230	–	–	–
1899,	–	1,129	359	992	329	192	201	–	–
1900,	–	573	568	1,139	897	468	452	–	–
1901,	–	628	344	697	413	243	280	–	–
1902,	–	581	563	937	525	367	451	–	–
1903,	–	650	450	860	435	286	398	–	–
1904,	–	465	405	838	472	303	470	274	189
1905,	–	609	551	904	554	528	671	363	388
1906,	783	671	631	1,042	721	550	583	326	422
1907,	443	590	349	909	419	312	427	205	422
1908,	979	741	783	1,073	689	666	695	443	481
1909,	2,399	1,079	1,999	632	1,899	1,913	1,959	1,313	677
1910,	625	622	457	–	465	447	421	221	374
1911,	934	748	700	1,382	954	778	735	349	461
1912,	1,117	716	855	3,887	919	1,035	967	412	462
1913,	565	607	535	2,622	850	531	410	237	356
1914,	757	648	492	–	540	603	549	249	412
1915,	725	656	643	–	601	597	631	262	419
1916,	857	811	842	–	1,041	872	858	409	520
1917,	570	446	598	638	717	569	534	352	294
1918,	415	347	417	2,766	521	390	485	251	217
1919,	481	456	419	4,747	515	417	446	197	331
1920,	282	299	253	1,638	344	230	283	138	166

NOTE. — A large growth of Asterionella originated in the Wachusett Reservoir in 1909, causing a large number of organisms in the water of Sudbury Reservoir and Framingham Reservoir No. 3, Weston and Chestnut Hill reservoirs, Spot Pond and in the water drawn from taps.

TABLE No. 26. — *Number of Bacteria per Cubic Centimeter in Water from Various Parts of the Metropolitan Water Works, 1898–1920.*

[Averages of weekly determinations.]

YEAR.	CHESTNUT HILL RESERVOIR.			SOUTHERN SERVICE TAPS.	
	Sudbury Aqueduct Terminal Chamber.	Cochituate Aqueduct.	Effluent Gate-house No. 2.	Low Service, 180 Boylston Street.	High Service, 1 Ashburton Place.
1898,	207	145	111	96	–
1899,	224	104	217	117	123
1900,	248	113	256	188	181
1901,	225	149	169	162	168
1902,	203	168	121	164	246
1903,	76	120	96	126	243
1904,	347	172	220	176	355
1905,	495	396	489	231	442
1906,	231	145	246	154	261
1907,	147	246	118	130	176
1908,	162	138	137	136	148
1909,	198	229	119	150	195
1910,	216	–	180	178	213
1911,	205	204	151	175	197
1912,	429	450	227	249	259
1913,	123	243	157	119	140
1914,	288	–	252	174	220
1915,	163	–	128	117	134
1916,	128	–	85	102	105
1917,	178	112	119	119	141
1918,	1,163	168	705	317	544
1919,	92	85	100	70	84
1920,	148	86	108	113	112

TABLE No. 27. — *Colors of Water from Various Parts of the Metropolitan Water Works in 1920.* (*Averages of Weekly Determinations.*)

[Platinum Standard.]

MONTH.	WACHUSETT RESERVOIR.						SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR No. 3.	LAKE COCHITUATE.			CHESTNUT HILL RESERVOIR.			SPOT POND.	FELLS RESERVOIR.	NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Surface.	Mid-depth.	Bottom.	Worcester Street Bridge.	Quinapoxet River.	Stillwater River.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Mid-depth.	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.	Mid-depth.	Effluent Gate-house.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 180 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January,	12	12	12	22	26	22	14	15	16	15	15	18	17	23	16	–	15	7	7	15	7	15	15
February,	12	12	11	24	30	21	14	14	15	19	15	23	17	23	15	–	14	8	7	14	7	14	14
March,	17	17	14	32	34	30	17	17	22	52	20	34	19	32	17	–	15	10	10	15	9	15	15
April,	18	17	19	28	35	33	27	27	28	26	27	31	30	30	26	–	23	17	11	23	12	23	23
May,	17	17	18	30	43	40	20	20	20	58	21	24	23	25	21	–	20	11	10	20	10	20	20
June,	19	18	19	41	52	47	21	21	22	22	22	25	22	34	22	–	20	10	10	20	10	20	20
July,	17	17	17	28	52	49	21	22	22	18	21	22	22	64	20	–	19	10	10	19	10	19	19
August,	16	16	17	21	31	31	17	18	18	16	18	18	20	56	18	–	16	11	11	18	11	17	17
September,	15	16	16	17	28	22	15	16	16	15	12	16	19	98	16	–	15	11	11	15	11	16	15
October,	14	14	15	24	41	38	14	15	15	15	15	14	–	110	15	14	14	11	11	14	10	14	14
November,	13	13	13	16	40	34	14	13	14	14	14	15	16	98	14	14	13	11	10	13	10	13	13
December,	13	13	14	47	37	32	15	15	14	15	15	16	16	16	14	–	13	11	10	13	10	13	13
Averages,	15	15	15	28	37	33	17	18	19	24	18	21	20	51	18	14	16	11	10	17	10	17	17

TABLE No. 28. — *Temperatures of Water from Various Parts of the Metropolitan Water Works in 1920. (Averages of Weekly Determinations.)*

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth at place of observation is from high-water mark.]
[Degrees Fahrenheit.]

Month.	Wachusett[1] Reservoir (Depth at Place of Observation 107 Feet).			Sudbury[1] Reservoir (Depth at Place of Observation 54.5 Feet).			Wachusett Aqueduct.	Framingham[1] Reservoir No. 3 (Depth at Place of Observation 20.5 Feet).			Lake Cochituate[1] (Depth at Place of Observation 62.0 Feet).			Chestnut Hill Reservoir.	Spot Pond[1] (Depth at Place of Observation 28.0 Feet).			Northern Service.		Southern Service.	
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Effluent Gate-house No. 2.	Surface.	Mid-depth.	Bottom.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 180 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January,	34.5	35.5	35.8	34.0	35.5	36.0	35.8	34.1	34.7	34.6	34.4	37.5	38.5	36.0	35.6	36.0	36.0	38.4	38.0	37.1	37.9
February,	33.1	35.5	36.0	33.9	35.0	36.5	35.5	34.1	34.3	34.6	33.5	37.5	38.7	35.2	35.9	36.4	37.5	37.9	37.8	36.5	37.3
March,	34.1	35.5	37.5	34.4	35.0	37.0	34.0	35.6	36.0	36.0	35.4	38.0	39.6	36.2	36.0	36.8	38.3	38.2	38.2	37.0	38.0
April,	39.0	40.0	38.3	41.9	41.0	43.0	40.5	43.9	44.9	38.5	40.8	41.0	40.9	43.5	42.4	42.3	42.8	44.1	43.9	44.3	44.7
May,	49.3	48.3	42.6	53.3	49.8	49.5	49.5	53.6	54.3	51.4	53.2	46.6	45.2	51.8	52.1	50.5	53.3	52.8	53.3	53.1	53.8
June,	62.9	58.2	50.0	64.3	59.8	54.0	58.0	65.9	62.6	62.5	66.3	48.2	45.3	64.1	65.6	62.8	62.5	62.0	63.8	63.7	67.0
July	69.9	64.2	50.8	72.0	67.0	60.3	56.5	72.9	70.5	70.3	73.3	48.9	45.8	70.8	72.5	71.0	71.3	69.8	71.3	71.2	71.6
August,	73.4	63.3	51.2	77.5	68.5	66.2	58.5	74.7	74.2	71.5	74.7	49.6	45.8	73.6	74.7	74.3	74.0	72.7	74.4	73.7	73.9
September,	66.5	64.5	53.5	68.0	68.0	64.8	59.0	67.6	67.6	65.2	67.7	49.7	46.1	68.4	69.2	67.8	70.0	68.3	69.0	68.8	69.4
October,	61.3	62.0	49.8	61.1	62.3	60.3	58.5	60.6	61.3	59.7	59.9	–	46.4	60.9	61.3	60.3	62.8	63.3	62.8	63.2	64.0
November,	50.7	49.3	48.1	48.2	49.0	48.8	48.0	46.5	46.6	51.2	48.0	44.3	44.6	48.5	48.7	49.0	48.8	53.4	53.0	51.2	52.5
December,	38.8	35.7	40.8	36.7	36.3	39.0	38.0	36.0	35.8	36.5	39.4	39.8	39.7	36.7	36.8	39.5	36.0	42.0	41.3	39.6	40.0
Averages,	51.1	49.3	45.5	52.1	50.6	49.6	47.7	52.1	51.9	51.0	52.2	40.1	43.1	52.1	52.6	52.2	52.8	53.6	53.9	53.3	54.2

[1] Surface temperatures are averages of weekly determinations. Mid-depth and bottom temperatures are averages of biweekly determinations.

TABLE No. 29. — *Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1920.*

[Degrees Fahrenheit.]

MONTH.	CHESTNUT HILL RESERVOIR.			FRAMINGHAM.			CLINTON.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
January, ...	45	—17	17.0	46	—13	19.5	49	—15	17.5
February, . . .	47	—19	22.6	45	—16	24.2	42	—20	23.1
March, ...	68	—3	34.7	68	4	37.2	67	—3	35.2
April, ...	72	31[1]	–	72	23	45.1	70	21	42.7
May, ...	86	34	54.8	87	31	55.7	81	30	53.4
June, ...	90	43	65.2	90	45	66.1	85	44	63.5
July, ...	89	48	70.3	89	47	71.2	84	52	68.9
August, ...	92	42	72.1	91	48	72.5	86	47	70.2
September, . . .	89	38	64.5	87	39	64.9	85	40	63.1
October, ...	–[1]	34	–	81	34	58.9	77	33	57.3
November, . . .	–[1]	20	–	62	20	38.9	67	12	38.6
December, . . .	67	5	36.7	56	5	33.3	50	5	32.0
Averages for the year, .	–	–	–	–	–	48.95	–	–	47.12

[1] Thermometer out of order.

TABLE No. 30. — *Length of Metropolitan Water Works Main Lines and Connections and Number of Valves set in Same, Dec. 31, 1920.*

[Pipes are of cast-iron unless otherwise noted.]

	Diameter of Pipes in Inches.															Total.
	60	48	42	40	36	30	24	20	16	14	12	10	8	6	4	
Total length owned and operated Dec. 31, 1919 (feet).	43,802[1]	211,092	9,810	6,887	63,626	49,775[2]	85,506	85,719	74,069	26	28,661	3,829	1,878	994	33	665,707
Gate valves in same,	5	56	1	3	60	45	61	56	82	1	112	20	18	23	1	544
Air valves in same,	51	125	5	5	47	22	43	51	37	–	11	1	–	–	–	398
Length laid or relaid during 1920 (feet),	–	10	–	–	–	–	–	15	172	–	182	13	–	–	–	392
Gate valves in same,	–	–	–	–	–	–	–	–	4	–	5	1	–	–	–	10
Air valves in same,	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1
Length abandoned during 1920 (feet),	–	10	–	–	–	–	–	15	9	–	67	8	–	–	–	109
Gate valves in same,	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
Air valves in same,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Length owned and operated Dec. 31, 1920 (feet).	43,802[1]	211,092	9,810	6,887	63,626	49,775[2]	85,506	85,719	74,232	26	28,776	3,834	1,878	994	33	665,990[3]
Gate valves in same,	5	56	1	3	60	45	61	56	86	1	116	21	18	23	1	553
Air valves in same,	51	125	5	5	47	22	43	51	38	–	11	1	–	–	–	399

[1] Includes 2,035 feet of 76-inch concrete-lined pressure tunnel; 363 feet of 76-inch mortar-lined and concrete-covered steel pipe; 21 feet of 76-inch cast-iron pipe and 85 feet of 60-inch concrete-covered steel pipe.

[2] Includes 15,512 feet of 30-inch mortar-lined and covered wrought-iron pipe.

[3] 126.13 miles.

TABLE NO. 31. — *Length of Metropolitan Water Works Hydrant, Blow off and Drain Pipes, Dec. 31, 1920.*

[All pipes are of cast iron.]

	Diameter of Pipes in Inches.								Total.
	24	20	16	12	10	8	6	4	
Total length in use Dec. 31, 1919 (feet),	352	292	3,121	6,882	176	513	3,566	1,497	16,399
Valves in same,	–	–	30	109	2	9	85	45	280
Length laid or relaid in 1920 (feet),	–	–	–	–	–	–	93	–	93
Valves in same,	–	–	–	–	–	–	1	–	1
Length abandoned in 1920 (feet),	–	–	–	–	–	–	83	–	83
Valves in same,	–	–	–	–	–	–	1	–	1
Total length in use Dec. 31, 1920 (feet),	352	292	3,121	6,882	176	513	3,576	1,497	16,409[1]
Valves in same,	–	–	30	109	2	9	85	45	280

[1] 3.11 miles.

TABLE No. 32. — *Length of Metropolitan Water Works Main Lines and Connections and Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1920.*

BY WHOM OWNED.	INCHES.																TOTALS.	
	60	48	42	40	36	30	24	20	18	16	14	12	10	8	7	6	4	Feet.	Miles.
Metropolitan Water Works,	43,802	211,092	9,810	6,887	63,626	49,775	85,506	85,719	–	74,232	26	28,776	3,834	1,878	–	994	33	665,990	126.14
Arlington,	–	–	–	–	–	–	–	–	–	–	–	25,208	29,541	40,693	–	151,304	15,617	262,363	49.69
Belmont,	–	–	–	–	–	–	–	–	–	–	–	5,714	16,954	27,365	–	120,101	269	170,403	32.27
Boston,	–	10,607	15,683	16,081	37,132	93,223	79,090	86,466	–	269,954	5,041	1,469,580	412,910	834,920	–	1,195,727	100,105	4,626,519	876.23
Chelsea,	–	–	–	–	–	–	–	–	–	5,176	–	5,479	39,826	30,268	–	143,240	6,656	230,645	43.68
Everett,	–	–	–	–	–	–	2,484	2,900	–	5,204	5,998	6,084	42,876	25,930	–	147,297	30,600	269,373	51.02
Lexington,	–	–	–	–	–	–	–	–	–	–	–	9,000	4,879	35,433	–	125,153	27,794	202,259	38.31
Malden,	–	–	–	–	–	–	–	–	–	8,891	9,179	83,922	31,300	90,437	–	225,935	51,318	500,982	94.88
Medford,	–	–	–	–	–	–	–	673	–	6,775	9,598	32,600	40,019	99,296	–	170,966	26,348	386,275	73.16
Melrose,	–	–	–	–	–	–	–	–	–	5,223	3,024	23,097	20,334	25,731	–	153,434	55,209	286,052	54.18
Milton,	–	–	–	–	–	–	–	–	–	103	44	22,556	20,926	55,932	–	157,380	17,551	274,492	51.99
Nahant,	–	–	–	–	–	–	–	–	–	–	4,000	150	11,550	4,800	–	36,800	57,218	114,518	21.69
Quincy,	–	–	–	–	–	–	–	2,679	–	23,232	–	29,840	47,182	148,487	994	384,878	94,484	731,776	138.59
Revere, [1]	–	–	–	–	–	–	–	–	–	23,813	6,970	26,030	29,146	36,221	–	106,762	71,808	300,750	56.96
Somerville,	–	–	–	–	–	–	–	4,210	367	4,135	7,950	92,944	57,626	107,960	–	214,376	21,466	511,034	96.79
Stoneham,	–	–	–	–	–	–	–	–	–	–	–	7,425	1,825	5,110	–	108,595	18,797	141,752	26.85
Swampscott,	–	–	–	–	–	–	–	–	–	–	3,045	6,714	19,381	6,593	–	87,798	8,692	132,223	25.04
Watertown,	–	–	–	–	–	–	–	–	–	2,991	11,877	5,959	19,364	30,286	–	140,644	11,816	222,937	42.22
Winthrop,	–	–	–	–	–	–	–	–	–	–	–	4,049	24,198	34,652	–	55,129	56,174	174,202	32.99
Total feet,	43,802	221,699	25,493	22,968	100,758	142,998	167,080	182,647	367	429,729	66,752	1,885,127	873,671	1,641,992	994	3,726,513	671,955	10,204,545	–
Total miles,	8.30	41.99	4.83	4.35	19.08	27.08	31.64	34.59	0.07	81.39	12.64	357.03	165.47	310.98	0.19	705.78	127.27	–	1,932.68

[1] Includes a small portion of Saugus.

TABLE NO. 33. — *Number of Service Pipes, Meters, Per Cent of Services metered, Fire Services and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1920.*

CITY OR TOWN.	Services.	Meters.	Per Cent of Services Metered.	Services used for Fire Purposes only.	Fire Hydrants.
Arlington,	3,318	3,318	100.00	15	519
Belmont,	1,903	1,903	100.00	3	283
Boston,	107,708	67,282	62.46	1,930	9,786
Chelsea,	5,256	5,222	99.35	59	403
Everett,	6,140	4,378	71.30	24	647
Lexington,	1,353	1,339	98.97	6	226
Malden,	8,406	8,186	97.38	52	596
Medford,	6,892	6,892	100.00	20	730
Melrose,	4,480	4,429	98.86	20	383
Milton,	2,216	2,216	100.00	1	448
Nahant,	774	579	74.81	–	102
Quincy,	11,027	10,107	91.66	18	1,253
Revere,[1]	4,822	3,895	80.77	5	318
Somerville,	13,614	10,597	77.84	41	1,243
Stoneham,	1,696	1,690	99.65	–	157
Swampscott,	2,011	2,011	100.00	2	208
Watertown,	3,471	3,471	100.00	21	432
Winthrop,	3,018	3,004	99.54	5	322
Totals,	188,105	140,519	74.70	2,222	18,056

[1] Includes small portion of Saugus.

TABLE No. 34. — *Elevation of the Hydraulic Grade Line, in Feet, above Boston City Base for Each Month at Stations on Metropolitan Water Works during 1920.*

1920.	Low Service.												Southern High Service.					
	Boston Engine House, Bulfinch Street.		Allston Engine House, Harvard Street.		Medford, near Mystic Reservoir.		Somerville Public Library, Highland Avenue.		Malden Water Works Shop, Green Street.		Chelsea Court House.		Boston Metropolitan Water Works Office, 1 Ashburton Place.		Watertown Water Works Office, Main Street.		Belmont Water Works Shop, Waverley Street.	
Month.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
January,	145	134	177	172	165	162	166	162	165	161	163	149	244	226	257	243	259	248
February,	147	136	177	172	164	161	165	161	165	160	164	150	245	228	258	244	259	247
March,	151	139	176	173	165	162	167	161	165	160	165	151	245	226	259	244	259	246
April,	152	141	178	169	166	162	168	161	166	161	166	154	246	227	258	247	259	245
May,	152	138	176	169	166	162	167	162	165	160	165	154	246	227	260	245	259	244
June,	152	141	178	172	167	164	167	162	167	162	166	155	245	227	260	245	259	241
July,	153	138	178	174	168	164	166	161	167	162	166	156	246	227	260	249	258	237
August,	154	139	178	174	168	164	168	162	167	162	165	154	246	224	261	248	258	233
September,	152	139	178	169	167	163	168	161	167	162	165	152	246	224	261	253	260	246
October,	154	142	178	168	168	163	167	160	167	162	166	154	246	225	262	253	260	246
November,	155	143	177	168	167	163	166	160	167	162	165	155	247	225	262	255	261	249
December,	152	143	177	168	167	163	167	161	167	163	165	154	246	226	263	255	261	247
Averages,	152	139	177	171	167	163	167	161	166	161	165	153	246	226	260	248	259	244

TABLE No. 34. — *Elevation of the Hydraulic Grade Line, in Feet, above Boston City Base, etc.* — Concluded.

1920. MONTH.	SOUTHERN HIGH SERVICE — Concluded.						NORTHERN HIGH SERVICE.										NORTHERN EXTRA HIGH SERVICE.	
	MILTON WATER WORKS OFFICE, ADAMS STREET.		FORBES HILL TOWER, QUINCY.		QUINCY WATER WORKS SHOP.		SOMERVILLE PUMPING STATION, CEDAR STREET.		MALDEN CITY HALL.		REVERE WATER WORKS OFFICE, BROADWAY.		LYNN ENGINE HOUSE, UNION SQUARE.		WINTHROP TOWN HALL, HERMAN STREET.		LEXINGTON TOWN HALL, MASSACHUSETTS AVENUE.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
January,	243	227	233	221	230	207	266	243	269	263	260	249	255	243	187	173	430	420
February,	245	230	237	225	232	211	266	243	269	263	258	250	256	241	188	173	430	419
March,	247	229	235	221	232	209	268	241	269	263	262	250	257	243	187	173	428	416
April,	249	231	238	224	235	213	269	243	270	263	264	252	258	246	188	176	430	421
May,	247	229	238	224	235	212	269	243	269	263	264	250	253	242	187	175	430	419
June,	247	225	238	219	236	203	268	243	268	261	259	242	248	232	186	172	431	421
July,	246	225	234	219	234	202	265	239	266	259	253	233	235	212	186	167	430	419
August,	243	225	235	220	233	206	268	246	266	261	260	243	248	224	185	170	436	410
September,	244	227	237	221	235	209	268	244	268	262	260	246	255	239	187	175	436	410
October,	244	227	237	221	235	209	268	244	268	262	260	246	254	239	187	175	435	410
November,	247	230	238	223	237	213	269	244	269	263	261	247	257	243	191	179	435	413
December,	247	231	237	224	236	214	268	244	270	263	264	253	257	245	191	178	436	421
Averages,	246	228	236	222	234	209	268	243	268	262	260	247	253	237	188	174	432	417

Appendix No. 3.

WATER WORKS STATISTICS FOR THE YEAR 1920.

The Metropolitan Water Works supply the Metropolitan Water District, which includes the following cities and towns: —

City or Town.	Population, Census of 1920.	Estimated Population, July 1, 1920.
Arlington,	18,665	18,780
Belmont,	10,749	10,880
Boston,	748,060	751,810
Chelsea,	43,184	43,380
Everett,	40,120	40,350
Lexington,	6,350	6,390
Malden,	49,103	49,350
Medford,	39,038	39,460
Melrose,	18,204	18,270
Milton,	9,382	9,420
Nahant,	1,318	1,330
Newton,[1]	46,054	46,210
Quincy,	47,876	48,200
Revere,	28,823	29,120
Somerville,	93,091	93,530
Stoneham,	7,873	7,890
Swampscott,	8,101	8,150
Watertown,	21,457	21,530
Winthrop,	15,455	15,590
Total population of Metropolitan Water District,	1,252,903	1,259,640
Portion of Saugus supplied by Revere,	–	280

[1] No water supplied during the year from Metropolitan Water Works.

Pumping.

Chestnut Hill Pumping Station No. 1: —

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used — Bituminous: 73.1 per cent Nanty-Glo, Davenport and South Fork. Anthracite: screenings, 26.9 per cent. Price per gross ton in bins: bituminous, $7 to $13.04; screenings, $5.86 to $7.74. Average price per gross ton, $10.37. Per cent ashes, 15.3.

Chestnut Hill Pumping Station No. 2: —

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used — Bituminous: 72.8 per cent Nanty-Glo, Davenport, South Fork and Clearfield District. Anthracite: screenings, 27.2 per cent. Price per gross ton in bins: bituminous, $6.98 to $17.86; screenings, $6.44 to $6.90. Average price per gross ton, $10.17. Per cent ashes, 16.9.

Spot Pond Station: —

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used — Bituminous: 62.8 per cent Clearfield District, Pool–10 and Pool–71. Anthracite: screenings, 37.2 per cent. Price per gross ton in bins: bituminous, $8.19 to $16.35; screenings, $5.04 to $7.03. Average price per gross ton, $11.70. Per cent ashes, 15.2.

Chestnut Hill Pumping Station No. 1.

	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Totals.
Daily pumping capacity (gallons),	16,000,000	20,000,000	30,000,000	66,000,000
Coal consumed for year (pounds),	–	–	–	3,814,711
Cost of pumping, figured on pumping station expenses.	–	–	–	$44,495 20
Total pumpage for year, corrected for slip (million gallons).	1,375.51	8.52	430.06	1,814.09
Average dynamic head (feet),	132.55	126.05	128.34	131.52
Cost per million gallons pumped,	–	–	–	$24.5276
Cost per million foot gallons,	–	–	–	.1865

Chestnut Hill Pumping Station No. 2.

	Engines Nos. 5, 6 and 7.	Engine No. 12.	Totals.
Daily pumping capacity (gallons),	105,000,000	40,000,000	145,000,000
Coal consumed for year (pounds),	–	–	14,597,063
Cost of pumping, figured on pumping station expenses,	–	–	$137,012 08
Total pumpage for year, corrected for slip (million gallons).	13,092.32	13,861.67	26,953.99
Average dynamic head (feet),	29.82	123.22	77.85
Cost per million gallons pumped,	–	–	$5.0832
Cost per million foot gallons,	–	–	.0653

Spot Pond Pumping Station.

	Engines Nos. 8 and 9.
Daily pumping capacity (gallons),	30,000,000
Coal consumed for year (pounds),	3,603,232
Cost of pumping, figured on pumping station expenses,	$38,979 06
Total pumpage for year, corrected for slip (million gallons),	3,286.58
Average dynamic head (feet),	134.64
Cost per million gallons pumped,	$11.8601
Cost per million foot gallons,	.0881

Consumption.

Estimated total population of the eighteen cities and towns supplied wholly or partially during the year 1920,	1,213,430
Total consumption (gallons), meter basis,	46,579,167,000 [1]
Average daily consumption (gallons), meter basis,	127,265,500
Gallons per day to each inhabitant, meter basis,	104.9

Distribution.

	Metropolitan Water Works.	Cities and Towns supplied by Metropolitan Water Works.
Kinds of pipe used,	–[1]	–[2]
Sizes,	76–4 inch.	48–4 inch.
Extensions, less length abandoned (miles),	.05	9.99
Length in use (miles),	126.13	1,932.68
Stop-gates added,	9	–
Stop-gates now in use,	553	–
Service pipes added,	–	2,865
Service pipes now in use,	–	188,052
Meters added,	–	4,778
Meters now in use,	–	140,475
Fire hydrants added,	–	83
Fire hydrants now in use,	–	18,056

[1] 69.5 per cent pumped; 30.5 per cent by gravity.

[2] Cast-iron, cement-lined wrought-iron, cement-lined steel and kalamine pipe.

Appendix No. 4.

Contracts made and pending during

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	148[1]	Section 74, Reading Extension, North Metropolitan System in Stoneham.	4	$30,692 00	$26,016 00[2]	Rendle-Stoddard Company, Chelsea.
2	1	Part of Section 76, reservoir, pump well, and building foundations, also 16-inch cast-iron force main, Reading Extension, North Metropolitan System in Wakefield and Reading.	8	70,424 00	70,179 00[2]	Bruno & Petitti, Boston.
3	4	Section 75, Reading Extension, North Metropolitan System in Stoneham and Wakefield.	8	29,588 50[2]	22,984 50	Antony Cefalo, Boston.

Contracts relating to the

1	145	Section 101, High-level sewer, Wellesley Extension, South Metropolitan System in Dedham and Needham.	5	$90,080 00	$72,046 60[2]	Rendle-Stoddard Company, Chelsea.
2	149[1]	Part of Section 99, High-level sewer, Wellesley Extension, South Metropolitan System in Dedham.	6	67,800 00	47,675 00[2]	John C. Cavanagh Company, Boston.

[1] Contract completed.

[2] Contract based upon this bid.

Appendix No. 4.

THE YEAR 1920 — SEWERAGE DIVISION.

North Metropolitan System.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1920.	10. Value of Work done Dec. 31, 1920.	
Sept. 17, 1919	April 30, 1920	– – –	$26,359 69	1
Feb. 11, 1920	–	For earth excavation and refilling in reservoir, pump well and building foundations, $100 per lin. ft.; for earth excavation and refilling in trench for 16-inch cast-iron force main, $4.75 per lin. ft.; for Portland cement brick masonry in manholes and special structures, $40 per cu. yd.; for Portland cement concrete masonry in reservoir, pump well and building foundations, $15 per cu. yd.; for rock excavation in reservoir, pump well and building foundations, $8 per cu. yd.; for rock excavation in trench for force main, $10 per cu. yd.	63,641 00	2
Sept. 29, 1920	–	For earth excavation and refilling in trench for 15-inch, 18-inch and 20-inch Akron pipe sewer, $4.10 per lin. ft.; for Portland cement brick masonry in manholes and special structures, $50 per cu. yd.; for Portland cement concrete masonry in trench and special structures, $16 per cu. yd.; for Portland cement boulder concrete masonry in trench, $12 per cu. yd.; for rock excavation in trench, $16 per cu. yd.	20,970 40	3

South Metropolitan System.

Sept. 17, 1919	–	– – –	$39,062 02	1
Sept. 29, 1919	May 4, 1920[3]	– – –	3,949 10	2

[3] Work stopped by arrangement of the Commission.

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	Amount of Bid. 5. Lowest.	6. Contractor.
3	2	Section 100, High-level sewer, Wellesley Extension, South Metropolitan System in Dedham.	3	$121,659 50	$118,157 00[1]	Bruno & Petitti, Boston.
4	3	Part of Section 99, High-level sewer, Wellesley Extension in Dedham.	3	96,300 00	88,237 50[1]	Rendle-Stoddard Company, Chelsea.

[1] Contract based upon this bid.

THE YEAR 1920 — SEWERAGE DIVISION — *Continued.*

South Metropolitan System — Concluded.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1920.	10. Value of Work done Dec. 31, 1920.	
May 19, 1920	–	For earth excavation and refilling in trench for 33-inch by 36-inch concrete sewer, $17 per lin. ft.; for Portland cement brick masonry in manholes and special structures, $40 per cu. yd.; for Portland cement concrete masonry in trench and special structures, $18 per cu. yd.; for rock excavation in trench, $10 per cu. yd.	$105,315 00	3
May 29, 1920	–	For earth excavation and refilling in trench for 33-inch by 36-inch concrete sewer and 30-inch cast-iron pipe, $46.50 per lin. ft.; for Portland cement brick masonry in manholes and special structures, $40 per cu. yd.; for Portland cement concrete masonry in trench and special structures, $21.50 per cu. yd.; for spruce piles in trench and river bed in place, $2 per lin. ft.; for rock excavation in trench, $9 per cu. yd.	77,542 50	4

CONTRACTS MADE AND PENDING DURING THE YEAR 1920 — SEWERAGE DIVISION. — *Concluded.*

Summary of Contracts.

	Value of Work done Dec. 31, 1920.
North Metropolitan System, 3 contracts,	$110,971 09
South Metropolitan System, 4 contracts,	225,868 62
Total of 7 contracts made and pending during the year 1920,	$336,839 71

Appendix No. 5.

FINANCIAL STATEMENT PRESENTED TO THE GENERAL COURT ON JANUARY 10, 1921.

The Metropolitan District Commissioner respectfully presents the following abstract of the account of the receipts, expenditures, disbursements, assets and liabilities of the Metropolitan Water and Sewerage Works for the year ending November 30, 1920, in accordance with the provisions of chapter 235 of the Acts of the year 1906.

Metropolitan Water Works.

Construction.

The loans authorized for expenditures under the Metropolitan Water acts, the receipts which are added to the loan fund, the expenditures for the construction and acquisition of works, and the balance available on December 1, 1920, have been as follows: —

Loans authorized under the Metropolitan Water acts, including appropriations under St. 1920, c. 530, to provide for the reinforcement of the low-service and the northern high-service pipe lines, the construction of a reservoir in Arlington for the northern extra high service, to provide additional pumping machinery for the northern high service at Spot Pond and the southern high service at Chestnut Hill pumping stations,		$45,685,000 00
Receipt from town of Swampscott for admission to Metropolitan Water District, paid into Loan Fund (St. 1909, c. 320),		90,000 00
Receipts from the sales of property which are placed to the credit of the Metropolitan Water Loan Fund: —		
For the year ending November 30, 1920,	$5,717 46	
For the period prior to December 1, 1919,	258,898 67	
		264,616 13
		$46,039,616 13

Amount approved for payment from the Metropolitan Water Loan Fund: —		
For the year ending November 30, 1920,	$39,256 93	
For the period prior to December 1, 1919,	43,247,502 46	
		$43,286,759 39
Balance December 1, 1920,		$2,752,856 74

The amount of the Metropolitan Water Loan bonds issued at the end of the fiscal year was $42,947,000, bonds to the amount of $34,000 having been issued during the year. Of the total amount issued, $41,398,000 were sinking fund bonds, and the remainder, amounting to $1,549,000, were issued as serial bonds.

At the end of the year the amount of outstanding bonds was $42,726,000, as bonds issued on the serial payment plan to the amount of $221,000 had been paid. During the fiscal year $43,000 in serial bonds has been paid.

The Metropolitan Water Loan Sinking Fund amounted on December 1, 1920, to $16,953,165.15, an increase during the year of $1,048,620.01.

Maintenance.

Amount appropriated for the maintenance and operation of works for the year ending November 30, 1920,	$815,683 52	
Receipts credited to this fund for the year ending November 30, 1920,	3,828 84	
		$819,512 36
Amount approved for maintenance and operation of works during the year ending November 30, 1920,	$789,696 32	
Deduct amount paid from appropriation for the year 1919,	21,185 75	
		768,510 57
Balance December 1, 1920,		$51,001 79

The Commission has also received during the year ending November 30, 1920, $107,200.93 from rentals, the sale of land, land products and power and from other proceeds from the operations of the Metropolitan Water Works which, according to section 18 of the Metropolitan Water Act, are applied by the Treasurer of the Commonwealth to the payment of interest on the Metropolitan Water Loan, to sinking fund requirements and expenses of maintenance and operation of works, in reduction of the amount to be assessed upon the Metropolitan Water District for the year.

Sums received from sales of water to municipalities not belonging to the District and to water companies, and from municipalities for admission to the District, have been applied as follows: —

For the period prior to December 1, 1906, distributed to the cities and towns of the District, as provided by section 3 of the Metropolitan Water Act,	$219,865 65
For the period beginning December 1, 1906, and prior to December 1, 1919, applied to the Metropolitan Water Loan Sinking Fund, as provided by chapter 238 of the Acts of 1907,	98,427 94
For the year beginning December 1, 1919, and ending November 30, 1920, applied to the Metropolitan Water Loan Sinking Fund, as provided by said last-named act,	7,847 45
	$326,141 04

Metropolitan Sewerage Works.

Construction.

The loans authorized under the various acts of the Legislature for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of the loans, and the expenditures for construction, are given below, as follows: —

North Metropolitan System.

Loans authorized for expenditures for construction under the various acts, including those for the Revere, Belmont and Malden extensions, North System enlargements and extensions, New Mystic sewer, Deer Island outfall extension, lowering sewer siphon under Malden river, balance of appropriation under chapter 76, Resolves of 1915, and for the Reading extension,	$7,512,365 73	
Receipts from sales of real estate and from miscellaneous sources, which are placed to the credit of the North Metropolitan System: —		
For the year ending November 30, 1920,	919 57	
For the period prior to December 1, 1919,	86,083 14	
		$7,599,386 44
Amount approved for payment from the Metropolitan Sewerage Loan Fund, North System: —		
For the year ending November 30, 1920,	$104,703 37	
For the period prior to December 1, 1919,	7,428,564 92	
		7,533,268 29
Balance December 1, 1920,		$66,100 15

South Metropolitan System.

Loans authorized for expenditures for construction under the various acts, applied to the construction of the Charles River valley sewer, Neponset valley sewer, High-level sewer and extensions (including Wellesley branch), and an additional appropriation authorized by St. 1920, c. 525, and for additional Ward Street station pumping plant, .	$9,912,046 27	
Receipts from pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System: —		
For the year ending November 30, 1920,	196 40	
For the period prior to December 1, 1919,	19,684 65	
		$9,931,927 32
Amount approved for payment from the Metropolitan Sewerage Loan Fund, South System: —		
On account of the Charles River valley sewer, ...	$800,046 27	
On account of the Neponset valley sewer,	911,531 46	
On account of the High-level sewer and extensions: —		
For the year ending November 30, 1920,	160,000 46	
For the period prior to December 1, 1919, ...	7,879,150 83	
		9,750,729 02
Balance December 1, 1920, ...		$181,198 30

The amount of the Metropolitan Sewerage Loan bonds issued at the end of the fiscal year was $17,311,412, bonds to the amount of $225,000 for the South System having been issued during the year. Of the total amount issued, $15,440,912 were sinking fund bonds, and the remainder, amounting to $1,870,500, were serial bonds.

At the end of the year the amount of the outstanding bonds was $17,066,912, as bonds issued on the serial payment plan to the amount of $53,500 had been paid during the year, $244,500 having been paid to December 1, 1920.

Of the total amount outstanding at the end of the year, $7,334,000 were issued for the North Metropolitan System and $9,732,912 for the South Metropolitan System. The Metropolitan Sewerage Loan Sink-

ing Fund amounted on December 1, 1920, to $5,168,524.03, of which $3,221,141.35 was on account of the North Metropolitan System and $1,947,382.68 was on account of the South Metropolitan System, an increase during the year of $472,950.96.

The net debt on December 1, 1920, was $11,898,387.97, a decrease of $301,450.96.

Included in the above figures for the North Metropolitan System is $925,500 in serial bonds, of which $154,500 has been paid, and $945,000 for the South Metropolitan System, of which $90,000 has been paid.

Maintenance.

North Metropolitan System.

Appropriated for the year ending November 30, 1920,		$292,576 56
Receipts from pumping and from other sources, which are returned to the appropriation: —		
For the year ending November 30, 1920,		520 67
		$293,097 23
Amount approved for maintenance and operation of Metropolitan Sewerage Works, North System: —		
For the year ending November 30, 1920,	$294,640 63	
Deduct amount paid from appropriation for the year 1919,	7,930 98	
		286,709 65
Balance December 1, 1920,		$6,387 58

South Metropolitan System.

Appropriated for the year ending November 30, 1920,		$182,603 02
Receipts from sales of property, reimbursement and for pumping, which are returned to the appropriation: —		
For the year ending November 30, 1920,		354 66
		$182,957 68
Amount approved for maintenance and operation of Metropolitan Sewerage Works, South System: —		
For the year ending November 30, 1920,	$177,681 49	
Deduct amount paid from appropriation for the year 1919,	3,254 25	
		174,427 24
Balance December 1, 1920,		$8,530 44